

NUCLEAR SCIENCE ABSTRACTS

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GENERAL

ATOMIC POWER

5833 TID-5261

Oak Ridge School of Reactor Technology, Tenn.
COURSE OUTLINES AND ENGINEERING PROBLEMS.
July 1955. 168p.

An outline of all phases of reactor technology including terminology, chemistry, materials used, engineering, shielding, control, analysis, and experiments is given. A number of reactor engineering problems and solutions are given. (B.J.H.)

RESEARCH PROGRAMS

5834

ATOMIC ENERGY RESEARCH AT HARWELL. K. E. B. Jay.
London, Butterworths Scientific Publications, 1955. 144p.
\$1.25.

This book discusses in very general terms the Harwell production program, especially of uranium and plutonium, their nuclear reactor design program, their isotope production program, their electronic instrument development program, some special techniques employed, and some of their administrative problems. Some of the Harwell research is then discussed in great detail. Particular attention is given to neutron spectrometry, a helium³ detector, neutron scattering studies, neutron cross sections, fission physics, cosmic ray research, chemistry of heavy elements, and the study of metals. (B.J.H.)

BIOLOGY AND MEDICINE

5835 UCRL-3020

California. Univ., Berkeley. Radiation Lab.
COMMENTS ON "CONTRIBUTION TO THE PROBLEM
OF CAROTINOID FUNCTION IN PHOTOSYNTHESIS,"
R. Y. Stanier, et al, for publication in *Nature*. M. Calvin.
June 8, 1955. 5p. Contract W-7405-eng-48.

The suggestion is made and the evidence adduced that carotinoids function to transport or convert the energy absorbed by chlorophyll. (auth)

RADIATION EFFECTS

5836 AECU-3049

Los Alamos Scientific Lab., N. Mex.
RELATION BETWEEN BACTEREMIA AND DEATH IN
MICE FOLLOWING X-RAY AND THERMAL COLUMN
EXPOSURES. Irene U. Boone, Kent T. Woodward, and
Payne S. Harris. [1955?]. 22p. Contract [W-7405-eng-36].

The role of endogenous infection was investigated as a contributory cause of death in mice irradiated with doses of 400 to 800 r x radiation and 480 to 616 rem of thermal column radiation. Results indicate a direct relationship

between mortality and bacteremia following exposure to both types of radiation (C.H.)

5837 HW-36734

Hanford Atomic Products Operation, Richland, Wash.
THE ABSORPTION OF FISSION PRODUCTS BY PLANTS.
J. H. Rediske, J. F. Cline, and A. A. Selders. May 17,
1955. 17p. Contract W-31-109-Eng-52.

The absorption of the important fission products by plants is quantitatively presented as a concentration factor which is defined as the ratio of the fission product concentration found in the leaves to the fission product concentration found in the nutrient substrate. Of the fission products, the isotopes of strontium were found to be the most important by virtue of their high concentration factor, long half life, and low maximum permissible amounts for animals. Iodine and barium follow in importance, with cesium moderately important in some soils. All other fission products have concentration factors less than strontium by 100 or more. The effect on the concentration factor of different agricultural plants, as well as different organs of the same plant, causes variations of about a factor of ten or less for each isotope. The concentration factor tends to increase as the pH of the nutrient substrate is decreased. Addition of stable carrier to the substrate does not decrease the amount of the radioactive isotope that is absorbed into the plant. The presence of iodine and yttrium carrier actually causes a significant increase in the concentration of the respective radioactive isotopes in the plant tissue. (auth)

5838 UCLA-341

California. Univ., Los Angeles. Atomic Energy Project.
TISSUE DEPOSITION OF POLYVINYLPYRROLIDONE IN
NORMAL AND IRRADIATED RABBITS. Harvey C. Upham,
F. Warren Lovell, Lawrence E. Detrick, Dorothy Highby,
Virginia Debley, and Thomas J. Haley. July 25, 1955.
29p. Contract AT-04-1-GEN-12.

5839 UCRL-3015

California. Univ., Berkeley. Radiation Lab.
THE METABOLISM OF INJECTED EGG LIPOPROTEIN
IN THE NORMAL AND IRRADIATED RABBIT. Thomas L.
Hayes and John E. Hewitt. May 26, 1955. 10p. Contract
W-7405-eng-48.

The metabolism of injected egg lipoprotein has been studied by ultracentrifugal methods in the normal and x-irradiated rabbit. On the basis of the removal of egg lipoprotein from the blood of normal and irradiated animals, it is concluded that there is no block produced in lipoprotein metabolism at the time of radiation or for at least four hours postirradiation. (auth)

5840 UR-398

Rochester, N. Y. Univ. Atomic Energy Project.
THE SUB-FABRIC FLASH BURN: A STUDY OF COVER
FACTOR IN ITS EFFECT ON PROTECTIVITY OF COTTON
OXFORDS. George Mixter, Jr. May 18, 1955. 15p.
Contract W-7401-eng-49.

Using the clipped, anesthetized white pig as an indicator,

the protectivity from thermal radiation of a series of cotton oxford fabrics was studied. No gross qualitative or quantitative relationship between cover factor and burn protection was observed in the series of fabrics available. (auth)

5841 UR-401

Rochester, N. Y. Univ. Atomic Energy Project. THE RELATIONSHIP OF THERMALLY INDUCED HEMOGLOBINEMIA TO VOLUME OF SKIN BURN. J. L. Lyon, A. J. Emery, Jr., H. E. Pearce, and T. P. Davis. May 27, 1955. 23p. Contract W-7401-eng-49.

The precept, that the mass of an animal's circulating hemoglobin is proportional to surface area, has been used to correlate levels of thermally induced hemoglobinemia with burn severity. Anesthetized pigs were burned over varying portions of their surface area, at graded exposure times in water at 80°C. Sections of skin, stained by various methods, were assessed for burn depth. Plasma samples were drawn at specified intervals post burn, and the hemoglobin content related to depth and surface area burned. A method has been evolved whereby the average depth of a burn may be estimated if the surface area relationships and post burn hemoglobin concentration are known. (auth)

5842

ON THE ROLE OF THE PEROXIDES IN THE FORMATION OF LESIONS PRODUCED BY RADIATION. P. Dubouloz and J. Dumas. *J. radiol. et electrol.* 36, No. 5-6, 343-5 (1955). (In French)

All the attacking agents provoking an inflammatory condition of the skin introduce the formation of peroxides which one can characterize by chemical or histochemical methods. These peroxides are not specifically from the attacking agent, but from a vitiation of the metabolism accompanying the inflammatory state. Certain physical agents immediately provoke the formation of primary peroxides. These are primarily the ultraviolet rays and to a lesser degree, x rays and burns. The discussion of the facts leads to the conclusion that these primary peroxides probably play a role in the production of lesions due to ultraviolet rays, but that the biological action of x rays is due to another mechanism. (tr-auth)

5843

FACTORS MODIFYING SENSITIVITY OF BACTERIA TO IONIZING RADIATIONS. G. E. Stapleton (Oak Ridge National Lab., Tenn.). *Bacteriol. Revs.* 19, 26-32(1955) Mar.

Inactivation of aqueous suspensions of cells is predominantly an intracellular, indirect effect, probably mediated by free radical production in the cell fluids, several systems have been found which can modify the efficiency of x- or γ rays in the production of the lethal effect investigated, the physiological state of the organism at the time of irradiation determines to some extent the sensitivity of the bacterium to radiation, and conditions have been found under which a moderate fraction of a population of irradiated bacterial cells can recover from the damaging effect of ionizing radiations. (auth)

5844

SOME EFFECTS OF X-IRRADIATION OF DIFFERENT EMBRYONIC STAGES OF THE TROUT (*SALMO GAIIRDNERII*). Arthur D. Welander (Univ. of Washington, Seattle). *Growth* 18, 227-55(1954).

The results of experiments are presented which involved the exposure of six different embryonic stages of rainbow

trout, ranging from one cell to hatching, to graded doses of x-rays, from 25 to 2570 r. (auth)

5845

SENSITIVITY TO X-RAYS OF THE EARLY CLEAVAGE STAGES OF THE SNAIL *HELISOMA SUBCRENATUM*. Kelshaw Bonham (Univ. of Washington, Seattle). *Growth* 19, 9-18(1955).

Prehatching mortality of snail eggs was used as a criterion of sensitivity to acute doses of x radiation. Progress of egg development was recorded photographically. A timetable of early cleavages is presented. Temperature affects developmental rate so that hatching occurs in 11 days at 71°F, but in only 7.5 days at 77°F. Stage of development was evaluated numerically permitting relationships to be established between dose and developmental attainment. In the 1- and 2-cell stages resting eggs withstood from 2 to 4 times as much radiation as cells undergoing mitosis. The LD₅₀ to hatching was 300r-400r for resting cells and about 100r for mitotic. Later embryonic stages were less sensitive. For the trochophore through early shelled embryo stages the LD₅₀ was between 500r and 1000r. Effectiveness of hard (200 pKV) X-rays did not differ significantly from that of soft (50 pKV). Greatest sensitivity during first or second cleavage coincided with the earliest indentation of the cell. Aceto-orcein staining showed this to be at metaphase of anaphase. Stained metaphase preparations gave a diploid chromosome count of 36. (auth)

5846

THE INDUCTION BY X-RAYS OF RECESSIVE LETHALS IN THE MATURE SPERM OF *MORMONIELLA VITRIPENNIS* (WALKER). George B. Saul, II (Univ. of Pennsylvania, Philadelphia). *Radiation Research* 2, 447-60(1955) July.

Mature males of the chalcidoid Hymenopteron *Mormoniella vitripennis* (Walker) were treated with x-rays at doses between 568 r and 5112 r and were then mated to virgin females differing from them by an allele at a single locus. A statistically significant deviation from a 1:1 ratio of the alleles in the F₂ progeny of an unmated F₁ female was taken to indicate the presence of a recessive lethal linked to the genetic marker. The numbers of lethals linked to two separate loci were computed for each dose administered. No evidence was obtained against the assumption of a linear dose-action curve for recessive lethals linked to either of the visible markers studied. The combined data for the two loci also showed no significant departure from linearity. The mutation rate per roentgen was calculated as 0.004% for lethals linked to one locus, known as the R locus, and as 0.001% for lethals linked to another locus, known as the black locus. The combined rate for both groups of lethals was 0.005%. The method did not measure the spontaneous rate of mutation or indicate any differences in the numbers of lethals carried in the stocks used in the experiments. The proportion of lethals linked to the R locus is greater than the proportion linked to the *bk* locus at all doses of x-rays. This may be due to differences in radiosensitivities or crossing-over frequencies of the chromosomes involved, or to the possible location of *bk* close to the end of a chromosome. Recessive lethals can exert their effects at any stage of development between the egg and the adult. (auth)

5847

EFFECTS OF 50 ROENTGENS AND 25 ROENTGENS FRACTIONAL DAILY TOTAL-BODY γ -IRRADIATION IN THE BURRO. John H. Rust, Bernard F. Trum, John J. Lane, U. S. Grant Kuhn, III, John R. Paysinger, and Thomas J.

Haley (Univ. of Tennessee, AEC Agricultural Research Program, Oak Ridge and Univ. of California School of Medicine, Los Angeles). Radiation Research 2, 475-82(1955) July.

A study has been reported on the response of the burro (*Equus asinus asinus*) to 50 r and 25 r fractional daily total-body Co^{60} γ radiation. The mean survival time for the 50 r/day study was 30 days with a range of 25 to 35 days, and in the 25 r/day animals it was 63 days with a range of 47 to 87 days. All hematologic values were decreased. Lymphocytes were the most sensitive cell, and eosinophils the most resistant. Platelets were reduced significantly with 725 r at 25 r/day. A pronounced hyperferremia was observed after 500 r in the 50 r/day animals and after 200 r in the 25 r/day group. This elevation continued until near death. The clinical syndrome was characterized by weight loss, ulcerations, hyperesthesia, and hemorrhagic diathesis. The similarities of response of the animals receiving 50 and 25 r/day with those receiving 100 to 400 r/day were discussed. (auth)

5848

POST-IRRADIATION TIME AND DOSE-RESPONSE STUDIES ON THE INCORPORATION OF P^{32} INTO DNA OF MOUSE TISSUES. Lola S. Kelly, J. Dorothy Hirsch, Genevieve Beach, and Anita H. Payne (Univ. of California, Berkeley). Radiation Research 2, 490-501(1955) July.

5849

ULCERATIVE COLITIS LESIONS IN IRRADIATED RATS. Sheldon C. Sommers and Shields Warren (New England Deaconess Hospital, Boston). Am. J. Digest. Diseases 22, 109-11(1955) Apr.

Crypt abscess lesions, such as occur in one type of human ulcerative colitis, were observed in 9% of a large series of irradiated parabiotic rats. Affected animals also showed following radiation injury a metaplastic granular abnormality of mucus-producing cells in salivary glands and gastrointestinal tract. Temporary hypofunction of the adrenal cortex in rats with a normal activity of ovarian corpus luteal or testicular interstitial cells was considered to encourage the development of intestinal crypt abscesses. (auth)

5850

BIOLOGICAL EFFECT ON ATOMIC BOMB GAMMA RADIATION. Eugene P. Cronkite, Victor P. Bond, W. H. Chapman, and R. H. Lee. Science 122, 148-50(1955) July 22.

4720 mice were exposed in aluminum containers to the gamma radiation of a nuclear detonation. Control studies were made by exposing another set of mice to laboratory sources of x rays of various energies. Graphs are given showing daily deaths as a function of dose and of time after exposure. It is concluded that the RBE of the nuclear radiation as compared to laboratory sources is approximately 1. (B.J.H.)

5851

CONDITIONED AVERSION TO SACCHARIN RESULTING FROM EXPOSURE TO GAMMA RADIATION. J. Garcia, D. J. Kimeldorf, and R. A. Koelling (U. S. Naval Radiological Defense Lab., San Francisco). Science 122, 157-8(1955) July 22.

Both saccharin solutions and water were made available to two groups of rats. Before irradiation, both groups showed a marked preference for the saccharin solution. After one group was exposed to γ radiation, it was found that these animals showed a definite decrease of preference for the saccharin. A 30 r exposure negated the previous

preference, while a 57 r exposure gave them a definite aversion to it. Thus the effectiveness of ionizing radiation to act as an unconditioned stimulus to animals is demonstrated. (B.J.H.)

5852

C^{14} -ACETATE INCORPORATION INTO LIVER LIPIDS AND GLYCOGEN OF IRRADIATED RATS. Margaret G. Morehouse and Ronald L. Searcy (Univ. of Southern California, Los Angeles). Science 122, 158-9(1955) July 22.

Female albino rats were irradiated with x rays, fasted, and then, along with a control group, fed a solution containing C^{14} . The irradiated animals show significant increases in percentage of liver glycogen. Total liver fatty acids show that irradiation increases incorporation of C^{14} about ten-fold over the controls. The same treatment was applied to a second group whose livers were extracted for lipids. It did not appear that radiation affected synthesis of phospholipids. Data from the two experiments are tabulated. (B.J.H.)

5853

RADIATION SENSITIVITY OF DORMANT AND GERMINATING BARLEY SEEDS. Calvin F. Konzak (Brookhaven National Lab., Upton, N. Y.). Science 122, 197(1955) July 29.

Striking differences in the relative sensitivity of seeds to x rays and thermal neutrons were observed. These differences were considered to be associated with changes in physiological state which differentially influence the relative efficiency of the two radiations. (auth)

5854

RADIATION SICKNESS IN MAN FOLLOWING THE ADMINISTRATION OF THERAPEUTIC RADIOIODINE. John D. Abbott and W. M. Court Brown (Postgraduate Medical School of London, England), and H. E. A. Farran (New End Hospital, London, England). Brit. J. Radiol. 331, 358-63(1955) July.

Radiation sickness occurring after therapeutic radioiodine administration as I^{131} has been observed on 28 out of 44 occasions. The symptoms have been described and their resemblance to the symptoms occurring after a single x-ray dose has been noted. The latent period prior to the onset of symptoms after radioiodine administration varied between 4 and 13 hours with a mean of eight hours. This finding has been contrasted with the latent periods of two to five hours after medium voltage x rays. The correlations between integral dose at eight hours per square meter and mean dose rate per hour to symptom onset per square meter and latent period have been noted. It is suggested that dose rate may be an important factor involved in the production of the symptoms of radiation sickness. (auth)

5855

THE DESTRUCTIVE EFFECTS OF RADIOACTIVE IODINE. J. A. Forbes (Univ. of Melbourne, Australia). Brit. J. Radiol. 331, 378-80(1955) July.

The effect of I^{131} radiation on thyroid gland and thyroid carcinoma tissue in rats was observed. It was concluded that no take-up and storage of I^{131} could be detected in uniformly cellular tumors in which no vesicles were observed or in cellular areas of well-differentiated thyroid-like tumors. Whereas normal thyroid was ultimately destroyed, destruction of well-differentiated tumor tissue was patchy. (B.J.H.)

5856

THE MODE OF ACTION OF THORIUM X ON HUMAN SKIN. Victor H. Witten and Marion B. Sulzberger (New York Univ.).

Am. J. Roentgenol. Radium Therapy Nuclear Med. 74, 90-7 (1955) July.

Possible mechanisms are discussed by which thorium X applied to human skin may produce its biological effects. (C.H.)

5857

REDUCTION OF LIFE SPAN OF RATS BY ROENTGEN IRRADIATION. J. B. Hursh, T. R. Noonan, G. Casarett, and F. Van Slyke (Rochester, New York). Am. J. Roentgenol. Radium Therapy Nuclear Med. 74, 130-4 (1955) July.

A comparison was made between the response of rats to single doses of 150, 300, and 600 r x radiation and the response to 600 r when administered as single and as divided doses. A single dose was found to produce a greater effect than the same total dose delivered in daily fractions. Possible explanations are presented. (C.H.)

5858

THE LETHAL DOSE OF TOTAL BODY COBALT-60 GAMMA RADIATION FOR THE RABBIT. John H. Rust, Glenn D. Folmar, Jr., J. J. Lane, and Bernard F. Trum (Oak Ridge, Tenn.). Am. J. Roentgenol. Radium Therapy Nuclear Med. 74, 135-8 (1955) July.

One hundred mature rabbits were exposed in groups of 10 to the gamma rays of cobalt-60 at the rate of approximately 45 r per hour. The $LD_{50/30}$ was 1,094 r and the confidence interval was 1,006-1,172 r. The mean survival time decreased as the dose increased and for all animals succumbing it was 9.1 days. The death pattern was unimodal. These data when compared with values for roentgen rays in the literature are in agreement with the general findings that a decreased dose rate and increased energy tend to reduce the effectiveness of the radiation. (auth)

5859

EFFECT OF OXYGEN TENSION ON THE PRODUCTION OF CHROMOSOME BREAKAGE BY IONIZING RADIATIONS: AN INTERPRETATION. C. P. Swanson (Johns Hopkins Univ., Baltimore and, Oak Ridge National Lab., Tenn.). pp.254-61 of "Proceedings of the Radiobiology Symposium held at Liege, August-September 1954."

5860

RADIOPATHOLOGIC CYTOLOGY. Carl Deden (Radium Centre, Copenhagen, Denmark). Acta Radiol. 43, 417-20 (1955) May.

A technique of preparing specimens with a view to a more uniform and reliable evaluation of cytologic radiation changes is described. (auth)

5861

NATURAL COLOURED PHOTOGRAPHS OF RADIATION SICKNESS CAUSED BY BIKINI ASHES. Y. Koyama, et al. Iryo (Tokyo) 9, 1-4 (1955) Jan. (In English and Japanese)

5862

RADIOISOTOPES IN BIOLOGY AND AGRICULTURE. PRINCIPLES AND PRACTICE. C. L. Comar (Oak Ridge Inst. of Nuclear Studies, Tenn.). New York, McGraw-Hill Book Co., Inc., 1955. 481p.

Procedures of radioisotope handling and their applications in the fields of biology and agriculture from the theme of this book. Procedures discussed in some detail are the principles and difficulties of tracer methodology, radioassay procedures, autoradiography, paper chromatography, ion exchange, and radioactivation analysis. Some of the applications discussed fully are health physics and radiation protection, and the handling of isotopes with animals and

plants. Extensive reference lists and a glossary of nuclear science terms are given. (B.J.H.)

RADIATION HAZARDS AND PROTECTION

5863 UR-402

Rochester, N. Y. Univ. Atomic Energy Project. IS THE CONCEPT OF "CRITICAL ORGAN" VALID IN DETERMINING THE MAXIMUM PERMISSIBLE LEVEL FOR EXPOSURE TO RADIOACTIVE MATERIALS? J. N. Stannard. June 8, 1955. 8p. Contract W-7401-eng-49.

This paper reviews, in part, the rationale of the critical organ concept in calculations of maximum permissible exposures to radioactive materials. It is shown that in many instances there is little evidence to indicate the existence of a critical organ. Furthermore, the choice is frequently quite arbitrary and without real evidence of damage to the organ in a chronic exposure situation, or evidence that the organ is critical in producing damage to the body as a whole. Very frequently, the only information available is the concentration of radioactive material in the various body organs and the organ with the highest concentration is perforce chosen as the critical organ. On the other hand, a review of the quantitative differences seen in maximum permissible operating levels when various possible critical organs are chosen or even entirely independent approaches used reveals that most values will lie within an order of magnitude range. While some of these differences may be important, a range of 10 is considered small in a field involving as many assumptions as that concerning the long term effects of radiolotopes. A review of pertinent parameters is urged, however, in cases where large issues such as cost, plant operating practices, etc. are involved. (auth)

5864

THE EFFECT OF GROWTH HORMONE ON RECOVERY FROM EXPOSURE TO X-RADIATION. John C. Barlow and E. A. Sellers (Univ. of Toronto, Canada). Radiation Research 2, 461-6 (1955) July.

The effect of growth hormone (GH) on some responses of the rat to x-irradiation of the whole body has been studied. GH had no effect on survival, on organ weights relative to body weight, or on histological changes after irradiation. The initial loss of body weight after sublethal radiation was partially prevented by GH. (auth)

5865

THE EFFECTIVENESS OF COLLOIDAL THORIUM DIOXIDE AS AN INTERNAL ALPHA EMITTER: A COMBINED MORPHOLOGIC AND RADIOAUTOGRAPHIC STUDY. Hermann J. Schaefer (U. S. Naval School of Aviation Medicine, Pensacola, Fla.) and Abner Golden (Emory Univ. School of Medicine, Georgia). Yale J. Biol. and Med. 27, 432-40 (1955) June.

Colloidal thorium dioxide (Thorotrast), administered intravenously to rabbits, accumulated in progressively larger deposits in reticuloendothelial cells, principally in the liver, spleen, and bone marrow. These deposits appeared to be quite bland and no evidence of hepatic fibrosis or instances of neoplasia were observed nine months after injection. Radioautographic studies indicated that a significant proportion of the energy of alpha radiation released during the experimental period was dissipated within the thorium deposits themselves and was ineffective for tissue dosage. (auth)

RADIATION SICKNESS

5866

CLINICAL COURSE OF THE RADIATION SICKNESS CAUSED BY BIKINI ASHES. INTERMEDIATE REPORT. Y. Koyama, et al. *Iryo (Tokyo)* 9, 5-45(1955) Jan. (In Japanese)

Clinical observations are summarized covering a 5-month period on 16 patients exposed to radioactive fall-out from the thermonuclear explosion on Bikini on March 1st, 1954. The patients were members of the crew of the 5th Lucky Dragon, a fishing boat, said to be located about 100 mi east of Bikini at the time of the explosion. Photomicrograms and photographs illustrate the text. (C.H.)

5867

PATHOLOGICAL FINDINGS IN THE FATAL CASE (THE LATE MR. KUBOYAMA) OF THE RADIATION SICKNESS CAUSED BY BIKINI ASHES. AN INTERMEDIATE REPORT. S. Ohashi, K. Hashimoto, N. Fukushima (1st Tokyo National Hospital), K. Tashiro, H. Sugano, and Y. Mori (Tokyo Univ.). *Iryo (Tokyo)* 9, 46-55(1955) Jan. (In Japanese)

Autopsy findings and the case history are summarized from a case diagnosed as radiation sickness caused by exposure to fall-out from a thermonuclear explosion. The patient died 207 days following exposure while on a fishing boat said to be located about 100 mi east of Bikini at the time of the explosion. Evidence was also found of a secondary virus hepatitis and *Aspergillus fumigatus* pneumonia. (C.H.)

5868

CONFERENCE OF THE RADIOACTIVE DISEASE CAUSED BY THE ATOMIC BOMB EXPLOSION IN THE CENTRAL PACIFIC. Y. Koyama, et al. *Iryo (Tokyo)* 9, 56-68(1955) Jan. (In Japanese)

RADIOGRAPHY

5869 UCLA-340

California. Univ., Los Angeles. Atomic Energy Project. GONAD DOSE DURING ROUTINE ROENTGENOGRAPHY. M. S. Billings, A. Norman, and M. A. Greenfield. July 22, 1955. 16p. Contract AT-04-1-GEN-12.

Measurements of the gonad dose received during routine roentgenography are presented together with some statistics of the distribution of these examinations in the population. It is calculated that the average dose due to these examinations accumulated by age thirty is only about five to fifteen per cent of the dose accumulated in that time from the natural background radiation. (auth)

5870

AUTORADIOGRAPHY IN BIOLOGY AND MEDICINE. George A. Boyd (Arizona Research Labs., Phoenix). New York, Academic Press Inc., Publishers, 1955. 399p.

The theory and techniques of autoradiography are reviewed. 813 references. (C.H.)

RADIOTHERAPY

5871

A DECISIVE PROGRESS IN TELECURIE THERAPY: THE TELECOBALT THERAPY. Robert Collez, Bernard Pierquin, and Maurice Tubiana. *J. radiol. et electrol.* 36, No. 5-6, 323-42(1955). (In French)

Complete details are given on the use of a cobalt source for radio therapy applications. Included are descriptions

of the sources, shielding, apparatus, control and treatment rooms which have been used. The advantages of cobalt therapy, the dose methods to be used in such therapy, and the therapeutic applications of cobalt therapy are also discussed in detail. (B.J.H.)

5872

RADIATION DOSIMETRY IN THE TREATMENT OF CARCINOMA OF THE CERVIX UTERI BY INTRAPARAMETRIAL RADIOACTIVE GOLD AND RADIUM. Michel Ter-Pogossian and Alfred I. Sherman (Washington Univ. Medical School, St. Louis, Missouri). *Am. J. Roentgenol. Radium Therapy Nuclear Med.* 74, 116-22(1955) July.

The radiation dosimetry of the combination of intraparametrial radioactive gold plus intracavitary radium, used in the treatment of carcinoma of the cervix uteri, is presented. The radiation distribution is correlated with the position of critical pelvic points involved in this form of treatment. The radiation delivered to the lateral parametrium by this form of therapy is 5,600 gamma roentgens and 10,000 to 11,000 rep. (auth)

TOXICOLOGY STUDIES

5873 CCC-1024-TR-121

Callery Chemical Co., Penna.

A CHEMICAL THERMOELECTRIC BORANE DETECTOR. L. J. Kuhns and R. H. Forsyth. July 12, 1955. 11p. Contract [NOa(s)-52-1024-c].

A carbon monoxide detector has been adapted for borane detection. Under ideal conditions, i. e., dry samples and the detecting unit held at constant temperature, the detector is sensitive to 0.2 ppm. pentaborane and 0.4 ppm. diborane. Considering the dynamic nature of the analysis, the quantitative results are very good. Since pentaborane has been found to be more toxic than diborane, the instrument's greater sensitivity to pentaborane is thought to be very much in the detectors favor. In operation, the combustion catalyst may have to be changed every eight hours, but it was found that this replacement had no effect on the reproducibility of results. The instrument's chief drawback is its extreme sensitivity to moisture. Provisions had to be made to remove water vapor from air samples if the detector was to be used to monitor atmosphere contaminated with boranes. Since no desiccating adsorbents could be found which did not also remove boranes, dehumidification by refrigeration was attempted. It was found possible to remove sufficient moisture by refrigeration from a pentaborane-air sample saturated with water vapor at room temperature. However, a thermal instability was produced in the detector. This was corrected by inserting a preheater in the line near the detector inlet. No detectable amount of pentaborane was removed under these conditions. If refrigeration of the sample air is practical, the chemical thermoelectric detector should prove very useful for borane detection. (auth)

TRACER APPLICATIONS

5874 UR-396

Rochester, N. Y. Univ. Atomic Energy Project, THE EARLY FATE OF POLONIUM²¹⁰ IN CATS. I. GASTROINTESTINAL ADMINISTRATION STUDIES. II. INTRAVENOUS ADMINISTRATION STUDIES. P. E. Morrow, Frank A. Smith, R. J. Della Rosa, Louis J.

Casarett, and J. N. Stannard. May 7, 1955. 25p. Contract W-7401-eng-49.

The absorption, distribution and excretion of polonium²¹⁰ citrate and neutralized polonium²¹⁰ chloride from isolated *in vivo* stomach pouches and intestinal segments and following intravenous administration to cats have been studied up to twelve hours. The experiments were designed to differentiate some of the effects of varying the dose, form, and absorption site of polonium by the use of tissue analyses, serial blood, bile, and urine analyses, and autoradiography. Significant absorption of polonium from the cat stomach occurs irrespective of the chemical form of polonium administered. The rate of absorption of ionic polonium from the intestine exceeds that for polonium colloid by a factor of ten. In the dose range, 3-18 μ c polonium per kilogram cat body weight, the rate of polonium absorption from the stomach and the intestine is proportional to the dose. Quantitative differences in the polonium distribution among organs and in the urinary excretion are primarily related to the site of administration. In addition, autoradiography of the tissues indicates that the cellular location of polonium varies only quantitatively. The urinary excretion data confirm the view that the excretion of polonium is maximal after absorption from the gastrointestinal tract. The renal clearance of polonium varies between 0.005 and 0.03 ml of whole blood per minute according to the form and site of the administered polonium. (auth)

5875

CLEARANCE OF RADIOACTIVE DUST FROM THE HUMAN LUNG. Roy E. Albert and Lawrence C. Arnett. *Arch. Ind. Health* 12, 99-106(1955) July.

The effective half life of thoron daughters in the lung following deposition, together with kaolin particles of mass-median diameter 1.1 μ to 1.3 μ , is about nine hours. This indicates that the pulmonary clearance of radon and thoron daughters under these conditions will not materially reduce the radiation hazard following inhalation. The early bronchial clearance of radioactive iron particles appears to have two phases. The first clearance period ends in 2 to 4 hours and the second in about 30 hours. The larger the average inhaled particle size, the greater the fraction removed in two to four hours. (auth)

5876

LOCALIZATION OF INTRACRANIAL LESIONS BY SCANNING WITH POSITRON-EMITTING ARSENIC. William H. Sweet and Gordon L. Brownell (Massachusetts General Hospital and Harvard Medical School, Boston). *J. Am. Med. Assoc.* 157, 1183-8(1955) Apr. 2.

By a technique for automatic scanning of the head after intravenous injection of positron-emitting arsenic 74 as sodium salt, two types of data are recorded simultaneously in records that we have called a positrocephalogram and an asymmetrogammagram. The technique is harmless, painless, and simple, the data automatically evolve pictorially, so that their preparation and interpretation require only a few minutes, and the localization in the sagittal plane is more precise than that obtainable when total gamma radiation only is counted. It guides the surgeon well for his exposure, eliminating the need for arteriography or pneumoencephalography in a growing number of cases. Accuracy is now about 75% for tumors and 83% for abscesses. Only 17% of patients with cerebral thrombosis or hemorrhage had abnormal scans. (auth.)

5877

THYROID FUNCTION ASSAY WITH RADIOIODINE. III. CLINICAL TEST RESULTS AND DIAGNOSTIC LIMITS FOR RATE CONSTANTS. T. H. Oddie, I. Meschan, and James T. Wortham (Univ. of Arkansas, Little Rock). *J. Clin. Invest.* 34, 1044-56(1955) July.

A series of 180 patients has been examined to determine their thyroidal status by the chemical protein-bound iodine and radioiodine methods, using the thyroidal uptake rate factor calculated from *in vivo* observations at 1, 4, or 24 hours after administration of the tracer dose. Good agreement has been found between the two methods in most cases. The experimental results, and those of others using some other radioiodine methods, are used to derive suggested diagnostic borderline values of several parameters in common use. (auth)

5878

OBSERVATIONS ON THE MECHANISM OF THE RENAL CLEARANCE OF I¹³¹. Neal S. Bricker and Charles J. Hlad, Jr. (Fitzsimons Army Hospital; V. A. Hospital, Denver, Colo.; and Univ. of Colorado School of Medicine, Denver). *J. Clin. Invest.* 34, 1057-72(1955) July.

The clearance of I¹³¹ has been determined (by the constant infusion technique) simultaneously with other renal functions in an attempt to establish the mechanism of iodide excretion in the human kidney. Fifty-eight clearance studies were performed on 49 subjects with varying states of thyroid function and varying states of renal function. Results are summarized. (auth)

CHEMISTRY

5879 RMO-2036

International Minerals and Chemical Corp., Chicago. AMMONIUM SULFATE DECOMPOSITION. Gordon L. Dugger, J. B. Adams, and Roger Bart. Feb. 28, 1955. 46p. Contract AT(49-1)-545. (IMCC-2207)

A process for the recovery of ammonia and sulfate values from ammonium sulfate has been developed. It involves a two-stage reaction, (NH₄)₂SO₄ + ZnO Low Temp. ZnSO₄ + 2NH₃ + H₂O and ZnSO₄ High Temp. ZnO + SO₂ + 1/2 O₂. Optimum conditions for these reactions are: intimate mixing of the solid reactants, a temperature of 400 to 500°C in the low-temperature stage, and a temperature of 800 to 1000°C in the high-temperature stage. Experimental data show that all nitrogen values are recovered as ammonia, uncontaminated by sulfur oxides, in the low temperature stage. Sulfur values given off in the high-temperature stage were found to be essentially all as sulfur dioxide. (auth)

5880 RMO-2046

International Minerals and Chemical Corp., Chicago. CRYSTALLIZATION OF AMMONIUM ALUM. Gordon L. Dugger, J. B. Adams, and Roger Bart. Feb. 28, 1955. 36p. (IMCC-2217)

Laboratory and pilot plant studies on the recovery of alumina as the ammonium alum from the filtrate of sulfuric acid-digested minus 200 mesh leached zone are discussed. Leached zone extract obtained from the filtration section was reacted with ammonium sulfate, with or without sulfuric acid addition, and the crude alum was recrystallized twice to obtain the desired purity. The effects

of starting-material variables on alumina recovery in crude alum were determined. (auth)

5881 RMO-2047

International Minerals and Chemical Corp., Chicago.
CONVERSION OF AMMONIUM ALUM TO ALUMINA.
H. W. Long, Jr., J. B. Adams, and Roger Bart. Feb. 28, 1955. 38p. Contract AT(49-1)-545. (IMCC-2218)

Objectives of this program were to convert by-product ammonium alum from Florida leached zone ore processing into metallurgical grade alumina, with recovery of ammonia and sulfate values as ammonium sulfate for recycle. Ammonium alum crystals are reacted with aqueous ammonia substantially as indicated in the equation: $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O} + 6\text{NH}_3 \rightarrow 2\text{Al}(\text{OH})_3 + 4(\text{NH}_4)_2\text{SO}_4$. The soluble salts are leached with water from the hydrated alumina particles formed. Ammonium sulfate and free ammonia are recovered from the wash liquors for reuse. A material analyzing $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ is produced by drying wet hydrated alumina at 110°C , which on being fired to 1150°C , yields calcined alumina. Estimated optimum conditions for the process steps as determined by laboratory experimentation are given. (auth)

5882 TID-5260

Oak Ridge National Lab., Tenn.
FUNDAMENTAL CHEMISTRY FOR NUCLEAR REACTOR ENGINEERS. Sigfred Peterson, R. W. Stoughton, William F. Kieffer, and S. A. Reynolds. May 1955. 102p. Contract [W-7405-eng-26].

A review of the concepts and theories of general chemistry and their practical applications which are of importance to the reactor technologist is presented in book form. Problems are included at the end of each chapter. (C.W.H.)

5883

MECHANISM OF $\text{S}_{\text{E}1}$ DECARBOXYLATIONS: EXAMPLES OF ELECTROMERIC ANIONOID HYPERCONJUGATION.
Richard E. Glick (Brookhaven National Lab., Upton, N. Y.). *Chemistry and Industry*, 716-17(1955) June 18.

Decarboxylations of 2,4,6-trinitrobenzoic and trichloroacetic acids have been postulated to occur via the first order decomposition of the anion ($\text{S}_{\text{E}1}$ reactions). A reaction mechanism which is consistent with experimental results is outlined for the acid decarboxylation. (C.W.H.)

5884

THE SYNTHESIS OF NITROGEN-CONTAINING KETONES. III. STUDIES WITH 2-METHYL-5-ETHYLPYRIDINE, 2,4-LUTIDINE AND LEPIDINE. Newton N. Goldberg and Robert Levine (Univ. of Pittsburgh). *J. Am Chem. Soc.* 77, 3647-8(1955) July 5.

The reactions of Li derivatives of 5-ethyl-2-methylpyridine and 2,4-lutidine with methyl benzoate to yield ketones were studied. Attempts were made to prepare the Li derivative of lepidine. (C.W.H.)

5885

ON THE DISSOCIATION ENERGIES OF SrO AND MgO MOLECULES. Richard F. Porter, William A. Chupka, and Mark G. Inghram (Univ. of Chicago, Ill. and Argonne National Lab., Lemont, Ill.). *J. Chem. Phys.* 23, 1347(1955) July.

The partial pressures of gaseous SrO and MgO in thermodynamic equilibrium with their respective solids were determined mass spectrometrically. In the SrO system, ion currents of Sr^+ , SrO^+ , and O_2^+ were observed; in the MgO system, Mg^+ was the major ion observed. Heats of sublima-

tion and dissociation were calculated for MgO and SrO . (C.W.H.)

ANALYTICAL PROCEDURES

5886 AWRE-O-65/54

Gt. Brit. Atomic Weapons Research Establishment, Aldermaston, Berks, England.

THE VOLUMETRIC ESTIMATION OF ZINC IN ALUMINIUM ALLOYS FOLLOWING SEPARATION BY ION EXCHANGE. Elizabeth M. Rees and K. Hartley. June 1955. 8p.

A method is described whereby Zn is separated from other elements in the Al alloy by adsorption on an anionic exchange column from 2M HCl and subsequently eluted by means of 0.01M HCl. The Zn in the eluate is then determined by titration with EDTA. (auth)

5887 TIB/T4377

POLAROGRAPHIC DETERMINATION OF URANIUM. (Polarografické Stanovení Uranu). Jan Doležal and Jiri Adam. Translated from *Chem. Listy* 48, 32-7(1954). 9p.

An analytical method, which is based on the behavior of U in the presence of 1,2-dihydroxybenzene 3,5-disulfonic acid in either NaOH or Na_2CO_3 , is developed for the polarographic determination of uranium. (C.W.H.)

5888

BERYLLIUM: ITS ESTIMATION AND SEPARATION FROM ALUMINIUM. C. Laxamana Sastri, G. Sriramulu, and Bh. S. V. Raghava, Rao (Andhra Univ., Waltair, India). *J. Sci. Ind. Research (India)* 14B, 171-4(1955) Apr.

The conditions for the precipitation of beryllium as beryllium oxinate have been determined and procedures for the estimation of beryllium by direct weighing of beryllium oxinate or by igniting it to the oxide are described. The composition of beryllium oxinate has been shown to be $\text{Be}(\text{C}_6\text{H}_5\text{NO})_2$. The use of benzylamine in the estimation of beryllium and removal of traces of aluminium therefrom has been described. Acridine and p-chloroaniline have been shown to be useful reagents in the quantitative separation of aluminium and beryllium. (auth)

5889

RAPID SEPARATION OF TRACER AMOUNTS OF RARE EARTH ELEMENTS OF THE YTTRIUM GROUP. Donald C. Stewart (Argonne National Lab., Lemont, Ill.). *Anal. Chem.* 27, 1279-82(1955) Aug.

A technique having possible applications in neutron activation analysis separates tracer amounts of the heavy rare earth elements in 30 minutes or less. The method is based on the use of buffered glycolic acid solution as an eluting agent for selectively removing the rare earths from cation exchange resin columns 1 cm or less in height. Data are presented relative to the importance of controlling the resin size, its initial chemical form, and the elutrient flow rate. Commercial glycolic acid contains calcium ion, which must be removed from the elutrient solution used with these very short resin columns. (auth)

5890

DETERMINATION OF TRACES OF CERTAIN RARE EARTHS IN ZIRCONIUM. ION EXCHANGE SEPARATION AND SPECTROGRAPHIC DETERMINATION OF FRAC-TIONAL PART-PER-MILLION AMOUNTS. Henry J. Hettel and Velmer A. Fassel (Iowa State Coll., Ames, Iowa). *Anal. Chem.* 27, 1311-14(1955) Aug.

An analytical method based on ion exchange separation of Zr as the fluozirconate anion, separation of the rare earths from other non-rare earth impurities by classical chemical separations, and spectrographic determination of Gd, Tb, Dy, Ho, and Sm in the Y used as a carrier is described for the determination of trace amounts of rare earths in zirconium. (C.W.H.)

5891

DETERMINATION OF PHOSPHORUS IN ALUMINUM AND ALUMINUM OXIDE BY RADIOACTIVATION ANALYSIS. L. M. Foster and C. D. Gaitanis (Aluminum Research Labs., New Kensington, Penna.). Anal. Chem. **27**, 1342-4(1955) Aug.

A method is described for determination of trace amounts of phosphorus in aluminum and aluminum oxide by neutron activation analysis. After a sample is irradiated in a slow neutron reactor, a large, known amount of carrier phosphorus is added, then a conventional chemical separation for phosphorus is made. The radioactivity of the separated phosphorus is compared with that of a standard treated in the same manner to give the phosphorus content of the unknown. Phosphorus contents in the range of 0.001 to 0.0001% were determined to 5% of the absolute value. (auth)

5892

ESTIMATION OF THORIUM BY ORGANIC REAGENTS. PART VII. SEPARATION FROM CERITE EARTHS AND OTHER METALS BY p-AMINOSALICYLIC ACID. Sachindra Kumar Datta and Gurupada Banerjee (Government Coll., Darjeeling, India). J. Indian Chem. Soc. **32**, 231-3(1955) April.

Thorium has been successfully separated from the cerite earths by p-aminosalicylic acid from solutions having thoria:cerite-earth oxide ratio 1:13 by single precipitation, and by double precipitation when the ratio is 1:23. Thorium can also be estimated from monazite sand; metals like U, Al, Cr, Ni, Co, Mn, Zn, Ca, Sr, Ba, and Mg in moderate amounts do not interfere with the estimations. (auth)

5893

MICRODIFFUSION OF ACETIC ACID AS AN ASSAY FOR ACETYLCHOLINESTERASE. Irving Serlin and George C. Cotzias (Brookhaven National Lab., Upton, N. Y.). J. Biol. Chem. **215**, 263-8(1955) July.

A simple, direct assay of acetylcholinesterase activity is presented. The procedure consists of a direct titration following microdiffusion of acetic acid from a reaction mixture, the pH of which has been fixed at 3.0. Hydrolysis of the excess, labile substrate is prevented and diffusion of the acetic acid is expedited by addition of the sample to anhydrous sodium sulfate at 4°. The procedure was found suitable for the assay of acetylcholinesterase preparations dilute enough to yield only 0.05 μ mole (3%) of acetic acid per ml per hour. (auth)

5894

NEW COLORIMETRIC DETERMINATION OF SMALL QUANTITIES OF FLUORIDE BY USING p-DIMETHYLAMINOAZOPHENYLARSONIC ACID Zr LAKE. Masaakira Kamada, Tomio Onishi, and Morio Ota (Kagoshima Univ., Japan). Bull. Chem. Soc. Japan **28**, 148-9(1955) March.

This procedure is based on the reaction of F^- with the acid Zr lake to complex the Zr lake and liberate the free acid. The liberated acid is separated from the insoluble Zr lake by filtering and the absorbancy of the free acid is measured in a colorimeter at 500 m μ and compared to a

standard. The F^- concentration must be in the range 0 to 1 ppm. A suggested use for this procedure is the determination of F^- in natural waters. (C.W.H.)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

5895

CHEMICAL EFFECTS ASSOCIATED WITH 'COLOUR CENTRES' IN ALKALI HALIDES. W. G. Burns and T. F. Williams (Atomic Energy Research Establishment, Harwell, Didcot, Berks, England). Nature **175**, 1043-4(1955) June 11.

A method of measuring the chemical effects of color centers in additively colored crystals and in x-ray irradiated crystals by measurement of the gas evolved on dissolution of a treated crystal in degassed water is described. Electron defect centers in irradiated NaCl crystals were measured by two methods, one based on measurement of free chlorine and another based on measuring oxidation of I^- . Results are given. (B.J.H.)

DEUTERIUM AND DEUTERIUM COMPOUNDS

5896

THE RELATIVE SOLUBILITY OF HYDROGEN AND DEUTERIUM IN LIQUIDS AT LOW TEMPERATURES. S. K. Lachowicz (Imperial Coll. of Science and Tech., London, England). Research (London) **8**, S27-8(1955) June.

The relative solubilities of H_2 and D_2 in liquid N_2 have been estimated from Hildebrand's solubility equation for regular solutions. (C.W.H.)

5897

VIBRATIONAL ENERGY OF DEUTERIUM CYANIDE. Harry C. Allen, Jr., Eugene D. Tidwell, and Earle K. Plyler (National Bureau of Standards, Washington, D.C.). J. Chem. Phys. **23**, 1356(1955) July.

Vibrational energy constants have been calculated for DCM from experimental data for the infrared spectrum. Agreement with previously reported values is good. (C. W. H.)

FLUORINE AND FLUORINE COMPOUNDS

5898 WADC-TR-52-191(Pt.2)

Purdue Research Foundation, Lafayette, Ind. FLUORINE-CONTAINING ELASTOMERS. [ANNUAL REPORT NO. 2 FOR THE PERIOD JUNE 11, 1952 TO JUNE 11, 1953]. O. R. Pierce and E. T. McBee. Oct. 1953. 54p. Contract AF-33(038)-20581. (AD-23169)

The syntheses of several fluorine-containing alkyl silanes which are to be used in polymerization studies toward evaluation as possible elastomer materials are described. (C.W.H.)

5899

HYDROXYFLUOBERYLLATES. PART I. Grihapati Mitra (Univ. Coll. of Science and Tech., Calcutta, India). J. Indian Chem. Soc. **32**, 241-5(1955) April.

The substitution of a hydroxyl group for fluorine atom in the fluoberyllate ion results in the formation of the hydroxy-fluoberyllate ion. The methods of preparation and properties of the hydroxyfluoberyllates of the alkali metals and ammonia have been discussed. The thermometric titration of potassium fluoberyllate by sodium hydroxide gives a break which corresponds to the formation of the hydroxy-fluoberyllate. The hydroxyfluoberyllates of the alkali metals are in general more soluble than the fluoberyllates, and some of the compounds are deliquescent. The ammonium

hydroxyfluoberyllate serves as a better starting material for the preparation of NH_4BeF_3 . From a theoretical consideration it has been shown that the hydroxyfluoberyllates should remain isoelectronic and isosteric with the sulphates, and this fact has been proved both from the chemical nature of the compounds and by x-ray analysis. (auth)

5900

HYDROXYFLUOBERYLLATES. PART II. HYDROXY-FLUOBERYLLATES OF Ca, Ba, Sr, Pb, Ce, La, AND Hg. Grihapati Mitra (Univ. Coll. of Science and Tech., Calcutta, India). *J. Indian Chem. Soc.* **32**, 246-8(1955) April.

The preparation and properties of some of the insoluble and sparingly soluble hydroxyfluoberyllates have been described. The hydroxyfluoberyllate of calcium, barium, strontium, and lead were prepared by the double decomposition between the nitrates of these metals and a soluble hydroxyfluoberyllate like the nickel hydroxyfluoberyllate. Lanthanum and cerium hydroxyfluoberyllates were prepared by the action of ammonium hydroxyfluoberyllate on the nitrates of these metals in presence of traces of amyl alcohol. The basic hydroxyfluoberyllate of mercury was also prepared. The fluoberyllates of Ce, La, and Hg have not been isolated as yet. Some of these hydroxyfluoberyllates are deliquescent in nature. These hydroxyfluoberyllates are more soluble than the corresponding fluoberyllates. The x-ray-diffraction diagram of the barium salt reveals that it is isomorphous with the corresponding sulphate. (auth)

5901

HEAT CAPACITY OF NiF_2 FROM 12 TO 300°K. THERMODYNAMIC FUNCTIONS OF NiF_2 . THE THERMAL ANOMALY ASSOCIATED WITH THE ANTIFERROMAGNETIC ORDERING. Edward Catalano and J. W. Stout (Univ. of Chicago, Ill.). *J. Chem. Phys.* **23**, 1284-9(1955) July.

The heat capacity of NiF_2 has been measured calorimetrically between 12 and 300°K. There is an anomaly in heat capacity rising to a maximum of $9.23 \text{ cal deg}^{-1} \text{ mole}^{-1}$ at 73.22°K. The anomaly is associated with the antiferromagnetic ordering of the magnetic moments of the nickel ions. Values of heat capacity, entropy, enthalpy, and free energy are tabulated at selected temperatures. The entropy at 298.16°K is $17.59 \pm 0.04 \text{ cal deg}^{-1} \text{ mole}^{-1}$. For the reaction $\text{NiF}_2 + \text{H}_2 = \text{Ni} + 2\text{HF}$, $\Delta H_0^\circ = 29.56 \pm 0.20 \text{ kcal}$ and $\Delta H^\circ = 30.06 \pm 0.20 \text{ kcal}$ at 298.16°K. (auth)

5902

INFRARED SPECTRUM OF SOF_2 . J. Kenneth O'Loane (Univ. of New Hampshire, Durham). M. Kent Wilson (Harvard University, Cambridge, Mass.). *J. Chem. Phys.* **23**, 1313-15(1955) July.

Infrared spectral data for gaseous SOF_2 are reported. The associated thermodynamic functions are calculated. (C.W.H.)

5903

THE FLUOROPLATINATES. III. THE ALKALI FLUOROPLATINATES. Thomas E. Wheeler, Theodore P. Perros, and Charles R. Naeser (George Washington Univ., Washington, D. C.). *J. Am. Chem. Soc.* **77**, 3488-9(1955) July 5.

The preparation and a few of the physical properties of the alkali fluoroplatinates are described. (C.W.H.)

GRAPHITE

5904 NYO-6681

Pennsylvania. State Univ., University Park. Mineral Industries Experiment Station.

FACTORS AFFECTING THE MECHANISM OF GRAPHITI-

ZATION AND THE HETEROGENEOUS GAS REACTIONS OF GRAPHITES. QUARTERLY PROGRESS REPORT [FOR] OCTOBER 1, 1954 TO DECEMBER 31, 1954. [PART I. CARBONIZATION AND GRAPHITIZATION. D. B. Murphy and W. V. Kotlensky. PART II. HETEROGENEOUS GAS REACTIONS OF CARBONS. A. CHANGES IN INTERNAL STRUCTURE OF A SPECTROSCOPIC GRAPHITE UPON GASIFICATION WITH CARBON DIOXIDE. Emile Raats.] Feb. 1, 195[5]. 38p. Contract AT(30-1)-1710.

Four types of carbon, distinguished by their physical appearance, have been prepared by the pyrolysis of benzene at 900°, 1200° and 1400°C. These types include the shiny and sooty varieties as well as a hard, gray and a spongy, black carbon, both of which are formed only at the higher temperatures. It is found that formation of the shiny and hard, gray carbons is favored, to the virtual exclusion of the sooty and spongy types, by increasing the surface in the pyrolysis zone through the use of packing. This suggests that the sooty and spongy types are formed in the gas phase, while the shiny and hard, gray carbons are plated out on solid surfaces. X-ray diffraction patterns for the carbons have been determined in the region of the (002) peak. From these patterns, d-spacings and L_c values have been calculated. The results show that the shiny and hard, gray carbons have similar d-spacings and crystallite heights, and that they are more graphitic in character than the sooty and spongy types. The d-spacings and crystallite heights of the spongy carbons are intermediate between the shiny and hard, gray carbons on the one hand and the sooty carbons on the other. This suggests that the spongy carbons are formed by the simultaneous deposition of the two main types. The study of the changes in pore geometry of graphite rods before and after gasification with carbon dioxide and its possible relation to the reactivity of the graphite has been continued. In this report, the changes in pore geometry of graphite rods are determined after a constant burn-off at temperatures between 970 and 1372°C. (auth)

5905 NYO-6682

Pennsylvania. State Univ., University Park. Mineral Industries Experiment Station.

FACTORS AFFECTING THE MECHANISM OF GRAPHITIZATION AND THE HETEROGENEOUS GAS REACTIONS OF GRAPHITES. QUARTERLY PROGRESS REPORT [FOR] JANUARY 1, 1955 TO MARCH 31, 1955. [PART I. CARBONIZATION AND GRAPHITIZATION. D. B. Murphy and W. V. Kotlensky. PART II. HETEROGENEOUS GAS REACTIONS OF CARBONS. C. GASIFICATION RATE STUDIES ON CARBONS AT LOW TEMPERATURES. A. F. Armington]. May 1, 1955. 22p. Contract AT(30-1)-1710.

An improved sample flask, which permits closer control of the rate of hydrocarbon input, has been constructed for use with the pyrolysis apparatus. A series of benzene pyrolyses have been carried out at 1200° and 1400°C. using various rates of hydrocarbon input. Toluene has also been pyrolyzed at 900°, 1200° and 1400°C. under conditions similar to those used for the decomposition of benzene. The pyrolysis of benzene at the relatively high concentration of 48% in the gas stream led to the deposition, at the beginning of the hot zone, of a carbon which was light, porous, brittle and much more easily crushed to a powder than the hard, gray D carbon usually formed at this point in the tube at lower benzene concentrations. Besides carbon, tar and gaseous products, an appreciable yield of

benzene was obtained in the pyrolysis of toluene at 900°C. This benzene was practically pure as collected, containing only a trace of toluene. At 1200°C, pyrolysis of toluene in an empty tube yielded only the sooty and spongy variety of carbons. A typical deposit of the hard, gray D carbon was formed at 1400°C. under the same conditions. Electron micrographs of the sooty carbons indicate an increase in particle size with increasing temperature of formation. An electron micrograph of a typical spongy (E) carbon is given showing the presence of small, round projections extending from the surface of the larger carbon particles. These projections appear to be characteristic of this type of carbon. An electron micrograph of a sooty carbon after graphitization is also presented, which clearly shows the development of polygonal outlines on the carbon particles. The procedure followed in graphitizing the carbons described in this and the previous quarterly reports is outlined, and the summary of the x-ray parameters of these carbons after heat treatment is presented. Heat-treatment of the A carbons results in formation of a graphitic material, whereas a non-graphitic product is formed from the B, D and E carbons. The lattice parameters of the heat-treated B, D and E carbons obtained from any one pyrolysis experiment are nearly the same, suggesting that these non-graphitic carbons, although different in external appearance, may have a similar mechanism of formation. The effect of reheating an A carbon to 1400°C., which was originally prepared at 900°, is to increase the perfection of the carbon lattice until it approximates that of the A carbons initially formed at the higher temperature. In general, it has been observed that the A carbons obtained at pyrolysis temperatures of 1200° and 1400° show a more highly developed graphitic structure after heat treatment than do those carbons prepared at a lower temperature. A description is also included of the microbalance apparatus, which is to be used to study low-temperature reaction rates of graphites and carbons. (For preceding period see NYO-6681.) (auth)

5906

RESEARCH ON THE INSERTION COMPOUNDS OF GRAPHITE. A. Herold. *Bull. soc. chim. France*. Nos. 7-8, 999-1012(1955) July-August. (In French).

The isobaric study of the graphite-potassium system leads to the formulas C_8K and $C_{24}K$ for the most important compounds. A method founded on their color differences permitted study of the chemical equilibrium $3C_8M \rightleftharpoons C_{24}M + 2M$ with $M = K, Rb$, and Cs , and calculation of heats of reaction. The stability of the compounds increases from K to Cs . Sodium does not react except about 900° in a welded steel tube. Lithium vapor becomes fixed at 500° on the graphite giving $CaLi_2$, but one observes intermediate members, of which the most homogeneous, yellow-gold, has the composition C_4Li . The isobaric study of the graphite-bromine system shows that the nature graphites give limit insertion products of the C_8Br formula, while artificial graphites give $C_{16}Br$. One part of bromine attaches itself in an irreversible manner, in order to give the residual compounds without definite formula. Iodine and chlorine are absorbed without being inserted. The insertion of elements in the lattice of graphite seems conditioned by their atomic radius. Only the large atoms give compounds of the C_8M formula. The bond is then of the metallic type. The smaller atoms tend to form bonds of the ionic type when they are electropositive (the case of lithium) and of the covalent type when they are electronegative (the cases of fluorine and oxygen) (tr-auth.)

5907

RATE OF EVAPORATION OF GRAPHITE. R. J. Thorn and G. H. Winslow (Argonne National Lab., Lemont, Ill.). *J. Chem. Phys.* 23, 1369(1955) July.

A procedure for the determination of the heat of sublimation of graphite is outlined. This method consists of measuring the rate of deposition by observing the change with time of the apparent temperature of the source measured through the deposit. Preliminary results indicate that the rate of sublimation from the graphite surface is lower than from the cell (C.W.H.)

5908

ENERGY EXCHANGE BETWEEN COLD GAS MOLECULES AND A HOT GRAPHITE SURFACE. Robert Gomer and Lothar Meyer (Univ. of Chicago, Ill.). *J. Chem. Phys.* 23, 1370(1955) July.

Experimental results indicate that the energy exchange between a smooth graphite surface and gas molecules proceeds by quasi-adsorption and evaporation, and independently of the graphite surface temperature under certain specified conditions (C.W.H.)

MOLECULAR STRUCTURE

5909 MCC-1023-TR-129

Syracuse Univ., N. Y.

THE STRUCTURE OF MAGNESIUM DIBORIDE. FINAL REPORT. Virginia A. Russell, Robert G. Hirst, Frank A. Kanda, and Aden J. King. Mar. 1955. 22p.

The preparation, properties, and crystal structure of magnesium diboride, MgB_2 , are described. The unit cell of MgB_2 has the dimensions $a_0 = 3.083 \pm 0.001$ Å, $c_0 = 3.521 \pm 0.001$ Å with an axial ratio of $c/a = 1.142$, and has a density of 2.667 g/cm³. MgB_2 is isomorphous with AlB_2 . Evidence indicates that electrons are transferred from the boron to the magnesium atoms. (C.W.H.)

5910 NP-5704

Wisconsin. Univ., Madison.

THE NATURE OF ADDITION COMPOUNDS OF ZIRCONIUM AND HAFNIUM TETRACHLORIDES WITH PHOSPHORUS OXYCHLORIDE. Edwin M. Larsen and Layton Whittenberg. June 1955. 15p. Technical Report VII under Contract N7onr-28504, Task Order 4. Title: CHEMISTRY OF HAFNIUM AND ZIRCONIUM.

Cryoscopic measurements were made in nitrobenzene on the $(Zr,Hf)Cl_4 \cdot 2POCl_3$, and $(Zr,Hf) \cdot POCl_3$ addition compounds. The 1:1 compounds are monomers, and the 1:2 compounds dissociate presumably to the 1:1 compound and $POCl_3$. The zirconium compound is slightly more dissociated than the hafnium compound. X-ray powder patterns of the tetrahalides, and the addition compounds, show the hafnium tetrachloride to be the same as the zirconium tetrachloride. The patterns of the addition compounds are of lower symmetry than those of the tetrahalides. (auth)

5911 AEC-tr-2188

MECHANISM OF AGING OF HYDROXIDES. Swarup Narian Tewari, Arun K. Dey, and Satyeshwar Ghosh. Translated by K. S. Bevis from *Z. anorg. u. allgem. Chem.* 271, 150-2 (1953). 3p.

$Al(OH)_3$ and $Cr(OH)_3$ were precipitated from $AlCl_3$ and $CrCl_3$ solutions using different amounts of alkali hydroxide. The relative change in their adsorptive ability for various ions in the aging process depends on the amount of alkali

hydroxide used for the precipitation. From this it is concluded that the dependence of the amount adsorbed on the age of the absorbent is limited by the decline in surface activity during aging as well as specific chemical reciprocal effects. (auth)

5912

POWDER DIFFRACTION STANDARDS FOR NIOBIUM PENT-OXIDE AND TANTALUM PENTOXIDE. L. K. Frevel and H. W. Rinn (The Dow Chemical Co., Midland, Mich.). Anal. Chem. **27**, 1329-30(1955) Aug.

Powder-diffraction data are presented for Ta_2O_5 prepared by direct oxidation of Ta metal and for a commercial sample of Nb_2O_5 . (C.W.H.)

RADIATION CHEMISTRY

5913 AECU-3047

New Mexico. Univ., Albuquerque.

THE DECOMPOSITION OF SOLID BARIUM NITRATE BY GAMMA RAYS (thesis). Lawrence E. LaMar. 1955. 48p. [For Los Alamos Scientific Lab. Contract W-7405-eng-36].

The rate of production of O_2 from $Ba(NO_3)_2$ samples which were irradiated with less than 2×10^7 r is 1.4 times the rate of production of the NO_2^- , while in $Ba(NO_3)_2$ samples which were irradiated with more than 2×10^7 r, the rate of production of O_2 is slightly less than the rate of production of NO_2^- . The rate of NO_2^- formation was found to be independent of the dose rate in the range 4×10^3 to 1.4×10^6 r/hr. A reaction mechanism is proposed for the decomposition of $Ba(NO_3)_2$ by gamma radiation. (C.W.H.)

5914

ION PAIR YIELDS IN THE X-RAY DECOMPOSITION OF HYDROGEN BROMIDE IN RARE GAS ATMOSPHERES.

Edward G. Zubler, William H. Hamill, and Russell R. Williams, Jr. (Univ. of Notre Dame, Indiana). J. Chem. Phys. **23**, 1263-7(1955) July.

The rate of x-ray induced decomposition of hydrogen bromide has been measured both in the pure gas and in rare gas atmospheres. The rate of ion pair formation under identical irradiation has been determined from the saturation ionization currents in rare gases and ion pair yields for decomposition of hydrogen bromide have been computed. Average yields were A-HBr, 4.7; Kr-HBr, 4.0; Xe-HBr, 4.7; HBr, 4.6; HBr-Xe, 5.2; where the first substance named is the major component. A mechanism for decomposition by ion formation accounts for a yield of 4.0. Values above this are attributed to dissociative excitation without ionization. (auth)

5915

THE EFFECT OF HIGH γ -RADIATION DOSAGE ON THE ORGANIC YIELDS OF Br^{80} , Br^{80m} , AND Br^{82} PRODUCED BY THE (n,γ) REACTION IN n-PROPYL BROMIDE. J. C. W. Chien and J. E. Willard (Univ. of Wisconsin, Madison). J. Am. Chem. Soc. **77**, 3441-4(1955) July 5.

Pure liquid n- C_3H_7Br subjected to high γ -ray exposures before or during neutron irradiation gives abnormally high organic yields for the $Br^{79}(n,\gamma)Br^{80m}$ (4.4 hr.), $Br^{79}(n,\gamma)Br^{80}$ (18 min.), and $Br^{81}(n,\gamma)Br^{82}$ (36 hr.) processes. The effect is most pronounced for the 36 hr. species and least for the 18 min. species. It is due to reaction of the HBr or Br_2 , formed as a result of the (n,γ) process, with olefin-like species formed from the C_3H_7Br by the γ -radiation. (auth)

RADIATION EFFECTS

5916

ON THE POLYMERIZATION OF METHYL METHACRYLATE

BY γ RADIATION. Adolphe Chapiro and Eva Migirdicyan. J. chim. phys. **52**, 439-40(1955) May. (In French)

Methyl methacrylate was radiated with Co^{60} and radium γ rays and conversion to polymeric form was observed. Up to 7% conversion, it was found that polymerization was a linear function of radiation time. (B.J.H.)

5917

PRODUCTION OF A BLUE COLOR IN IRRADIATED PLASTIC SCINTILLATORS. J. H. Pannell and B. Manning (Tech. Operations, Incorporated, Arlington, Mass.). J. Chem. Phys. **23**, 1368-9(1955) July.

The rates of production and decay of an intense blue color (absorption maximum at 580 m μ) in β -irradiated plastics containing certain fluors have been studied at 25 and $-70^\circ C$. An explanation based on an "F-center" theory in a non-crystalline environment is proposed. (C.W.H.)

5918

THE EFFECT OF IONIZING RADIATION ON AMINO ACIDS. III. THE EFFECT OF ELECTRON IRRADIATION ON AQUEOUS SOLUTIONS OF GLYCINE. Charles R. Maxwell, Dorothy C. Peterson, and William C. White (National Cancer Inst. and U. S. Dept. of Health, Education, and Welfare, Bethesda, Md.). Radiation Research **2**, 431-8(1955) July.

Oxygen-free and oxygen-saturated 1 M solutions of glycine have been irradiated with 50-kv x-rays at a dose rate of 1.6×10^3 rep/min and with 160-kv electrons at a dose rate of 2.5×10^6 rep/min. It is concluded from a comparison of the dose-yield data obtained from the various products that the initial radiation-induced reactions are the same for both irradiations. However, the role of subsequent reactions is of more importance at the lower dose rate. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

5919 AERE-Lib/Trans-497

THE EFFECT OF AMINO POLY-ACETIC ACIDS AND THE EXCHANGER FORM ON THE SEPARATION OF CERITE EARTHS. L. Holleck and L. Hartinger. Translated by F. Hudswell from Angew. Chem. **66**, 586-9(1954). 8p.

An abstract of this paper appears in Nuclear Science Abstracts as NSA 9-113.

5920

THERMOGRAVIMETRIC PYROLYSIS OF CUPFERRON COMPLEXES OF SCANDIUM, YTTRIUM, AND RARE EARTH ELEMENTS. Wesley W. Wendlandt (Texas Technological Coll., Lubbock). Anal. Chem. **27**, 1277-8(1955) Aug.

The thermogravimetric pyrolysis of the scandium, yttrium, and the rare earth cupferrates was determined. It was found that it is not necessary to ignite the complexes to $900^\circ C$ but that the oxide level is reached at 500 to $600^\circ C$. The construction and operation of a simple thermobalance are described. (auth)

SEPARATION PROCEDURES

5921 RMO-2006

International Minerals and Chemical Corp., Chicago.

SULFURIC ACID DIGESTION OF LEACHED ZONE. J. B. Adams, R. P. Nugent, Robert F. McCullough, and Judson G. Brown. Mar. 6, 1952. Decl. Apr. 13, 1955. 39p. Contract AT(49-1)-545.

The leached zone from the Florida Phosphate Divisions' operations has been subjected to various digestion procedures for solution of the uranium. Optimum conditions for

the digestion of the minus 200 mesh fraction of the leached zone in sulfuric acid are given. Optimum conditions for digestion of this fraction have been found to be a 15 minute digestion at 160 pounds per square inch pressure using 35% strength sulfuric acid and 80% of the amount of sulfuric acid necessary to react with all of the reactive elements present in the fraction to be digested. Samples of leached zone mined at Noralyn and Peace Valley properties and digested under the above optimum conditions show the percentage recoveries in solution. Filtration of leached zone after reaction with sulfuric acid under pressure gave filtering rates up to double that obtained by other digestion procedures. Laboratory data indicate the filter area required per ton of dry solids per 24 hours expressed on the basis of solids before digestion will be approximately 5 sq. ft. (auth)

5922

CONCENTRATION OF NITROGEN-15 BY CHEMICAL EXCHANGE IN A THERMAL DIFFUSION COLUMN. W. Spindel and T. I. Taylor (Columbia Univ., New York, N. Y.). *J. Chem. Phys.* 23, 1318-22(1955) July.

A concentration of nitrogen-15 has been effected in a thermal diffusion column under conditions where the gaseous exchange action, $N^{14}O_2 + N^{15}O \rightleftharpoons N^{15}O_2 + N^{14}O$, can contribute to the separative process. The top of the column is fed with NO_2 of normal isotopic abundance. Reversible thermal decomposition of NO_2 into NO and O_2 establishes a radial concentration gradient so that the descending cold stream is predominantly NO_2 and the inner hot ascending stream is largely NO and O_2 . As a result of the exchange reaction, N^{15} preferentially concentrates in the NO_2 and is carried to the bottom of the column. Here the enriched NO_2 re-enters the hot rising stream and is again decomposed into NO which undergoes further exchange. This reversible thermal decomposition makes it possible to operate the column without a chemical converter as was needed in the CO-CO₂ system. The over-all isotope separation has been studied in a two-meter column as a function of pressure (0.25 to 1.0 atmosphere), temperature (400 to 700°C) and withdrawal rate (5 to 66 cc atmospheres per day). A maximum over-all separation of 2.6 was obtained at a filament temperature of 685°C and a pressure of 0.5 atmosphere. At a withdrawal rate of 27 cc atmospheres the over-all separation is about 70 percent of this maximum value. (auth)

5923

ACID CURE: A NEW PROCESS FOR U_3O_8 . *Mining World* 17, No. 8, 46-50, 80(1955).

Since the reagent consumption would be excessive by treating high lime ores with dilute acid leach and since U in a reduced form associated with carbonaceous material does not respond readily to a dilute acid leach, the acid cure was found to make it possible to treat ores with intermediate lime content, and by proper blending and scheduling, to handle a certain amount of high lime ore, over 18% $CaCO_3$. (auth)

SPECTROSCOPY

5924 AEC-tr-2187

CHANGES OF SPECTRAL PROPERTIES OF STRUCTURAL PROTEINS OF MUSCLE IN THE PRESENCE OF ADENOSINTRIPHOSPHORIC ACID. Kh. M. Ravikovich, O. M. Setkina, and K. D. Leont'ev. Translated by V. Rimsky-Korsakoff from *Dokady Akad. Nauk S.S.S.R.* 60, 989-92(1948). 8p.

5925

INFRARED SPECTRA OF LIQUID ANHYDROUS HYDROGEN FLUORIDE, LIQUID SULFUR DIOXIDE, AND HYDROGEN FLUORIDE-SULFUR DIOXIDE SOLUTIONS. Robert H. Maybury, Sheffield Gordon, and Joseph J. Katz (Argonne National Lab., Lemont, Ill.). *J. Chem. Phys.* 23, 1277-81(1955) July.

The infrared spectra of anhydrous liquid hydrogen fluoride, anhydrous liquid sulfur dioxide and mixtures of the two have been measured in the region from 1μ to 25μ . A value for the extinction coefficient for the polymer peak in the region higher than previously reported has been found, reflecting the existence of a greater proportion of higher hydrogen fluoride polymers in the liquid as compared with the gas. A study of the change in the spectra of solutions of varying concentration of anhydrous liquid hydrogen fluoride in anhydrous liquid sulfur dioxide has been made and its possible relation to the structure of the polymers in liquid hydrogen fluoride examined. The possible applicability of obtaining spectra of protein dissolved in anhydrous liquid mixtures of hydrogen fluoride and sulfur dioxide has been explored and a spectrum of silk fibroin in this solvent is presented. (auth)

SYNTHESES

5926 WADC-TR-55-187

Peninsular ChemResearch, Inc., Gainesville, Fla. INVESTIGATION INTO THE USE OF HETEROCYCLIC COMPOUNDS AS LUBRICANT ADDITIVES. SUMMARY REPORT FOR THE PERIOD APRIL 1, 1954-APRIL 1, 1955. George B. Butler, O. Lee Gordon, and Louis A. Haynes. June 1955. 61p. Contract AF33(616)-2391.

A literature survey and synthesis program were carried out in order to prepare various nitrogen and sulfur, selenium, or oxygen-containing heterocycles for evaluation as antioxidant, antiwear, and extreme pressure additives for lubricants, hydraulic fluids, and greases. In addition, a number of organoselenium compounds of the selenide and diselenide types were synthesized, primarily for evaluation as high-temperature oxidation inhibitors. Solubilities of the prepared compounds in various referenced fluids were determined. (auth)

5927

THE REACTIONS OF CERTAIN FLUORINATED AND CHLORINATED ACETIC ACIDS WITH PHENYL LITHIUM IN REFLUXING ETHER. Thomas F. McGrath and Robert Levine (Univ. of Pittsburgh). *J. Am. Chem. Soc.* 77, 3634-6(1955) July 5.

The addition of trifluoroacetic acid to two or more equivalents of phenyllithium in refluxing ether gave none of the expected trifluoroacetophenone. Instead, some or all of the following cleavage products were obtained: benzoic acid, benzophenone, triphenylmethane and tetraphenylethylene. It is suggested that the trifluoroacetic acid is cleaved by phenyllithium to carbon dioxide and fluorocarbonyl and these compounds react with phenyllithium to give the observed products. Evidence in support of this scheme is given. The same products are obtained when trichloroacetic acid is treated with phenyllithium, while a mixture of benzophenone and 1,1-diphenylethane-1,2-diol (49%) is obtained from the reaction of chloroacetic acid and phenyllithium. (auth)

5928

THE SYNTHESIS OF CERTAIN KETONES AND CARBINOLS CONTAINING PERFLUOROALKYL GROUPS. Thomas F.

McGrath and Robert Levine (Univ. of Pittsburgh). *J. Am. Chem. Soc.* **77**, 3656-8(1955) July 5.

The addition of one equivalent of trifluoroacetic acid to two equivalents of phenyllithium in refluxing ether at 0° yields a mixture of trifluoroacetophenone and benzoic acid. Similar reactions were effected using perfluoropropionic and perfluoro-*n*-butyric acids. The reactions between the alkyl perfluoroalkanoates and phenyllithium to yield ketones and carbinols were also studied. (C.W.H.)

TRACER APPLICATIONS

5929

THE RETENTION OF METABOLIC RADIOACTIVE CARBONATE. R. Steele (Brookhaven National Lab., Upton, N. Y.). *Biochem. J. (London)* **60**, 447-53(1955) July.

A method is given and discussed for calculating the distribution of C¹⁴-labeled bicarbonate in an idealized 3-compartment animal. The procedure has been demonstrated in detail, using the data of Kornberg and Kornberg, and shows a fair correspondence between the real cat and the model. It is shown that different equations are required to express the retention of C¹⁴O₂ formed uniformly throughout the soft tissues and the retention of C¹⁴O₂ arising, or injected into, the blood. The parameters of the soft tissue equation are derivable from those of the blood equation. It is shown how measurements of the ratio of C¹⁴O₂ expired to the total C¹⁴O₂ of the body can give information as to whether C¹⁴O₂ is produced throughout the soft tissues or only in a small portion of them. In the latter case, the retention is more nearly described by the blood equation. (auth)

TRANSURANIC ELEMENTS AND COMPOUNDS

5930

THE PLUTONIUM-HYDROGEN SYSTEM. I. PLUTONIUM DIHYDRIDE AND DIDEUTERIDE. Robert N. R. Mulford and Gladys E. Sturdy (Los Alamos Scientific Lab., N. Mex.). *J. Am. Chem. Soc.* **77**, 3449-52(1955) July 5.

Pressure-temperature-composition data are presented for the Pu-H and Pu-D systems in the composition ranges Pu-PuH₂ and Pu-PuD₂. Heats of formation of PuH₂ and PuD₂ are calculated from the pressure-temperature data. Equations for the decomposition pressure-temperature relationships are given. (auth)

ENGINEERING

5931 K-1225

Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.

ULTRA LOW TEMPERATURE MECHANICAL REFRIGERATION. V. H. Kiplinger and D. M. Papke. July 22, 1955. 15p. Contract W-7405-eng-26.

A significant reduction in the diffusion pump cold trap temperature of special applications Line Recorder mass spectrometers from the -60° to -70°F obtainable with the present mechanical refrigeration system would result in lower residual signals, consequently the sensitivity of the instrument would be increased. A developmental model of a three-stage, mechanical refrigeration system with capacity sufficient to cool a Line Recorder diffusion pump cold trap to ultra low temperatures was fabricated and tested. The system used Freon-22, Freon-13, and Freon-

14 as the stage refrigerants, and the fractional horsepower, reciprocating type stage compressors were driven by 1/4-horsepower prime movers. The system produced a temperature of -220°F. at the third stage evaporator with a first stage condenser temperature of 70°F. However, the operating period was limited to four hours, because of the tendency of the compressor lubricating oil carried along with the refrigerants to freeze and plug the low temperature expansion devices. The use of oil separators did not eliminate this problem. Therefore, further work on ultra low temperature refrigeration for the Line Recorder cold trap is not recommended until the advent of a compressor lubricating oil with a pour point in the temperature range of -150° to -200°F. Theoretical calculations on this unit are presented in the Appendix. (auth)

5932 NP-5694

Pennsylvania State Univ., University Park.

THEORETICAL ANALYSIS OF SCABBING IN MATERIALS. INTERIM-TECHNICAL REPORT NO. 1. THE BASIC THEORY OF SCABBING IN MATERIALS WITH TWO SOLIDS IN CONTACT. PART I. ELASTIC THEORY. Norman Davids and Sudhir Kumar. May 31, 1955. 39p. Contract DA-36-061-ORD-465.

Basic relationships for scab formation in a solid are developed from the point of view of elastic materials. Relationships giving the thickness of scabs are obtained for semi-infinite plates and thin rods on the basis of normally incident pressure pulses of arbitrary form. The effect of a backing medium has been expressed in terms of impedance matching relations between the two media, and these used to determine quantitatively the reduction in stress. Criteria for required thicknesses are developed on the basis of momentum considerations. A preliminary treatment is included for spherically diverging waves arising from a point explosion in a semi-infinite medium. Some available data are made use of in a discussion for the purpose of evaluating time constants of typical pressure pulses used in the report. (auth)

5933 UCRL-2983

California. Univ., Berkeley. Radiation Lab.

PREDICTION OF CONCENTRATION GRADIENTS IN MULTI-COMPONENT MASS TRANSFER (thesis). Albert Fraser Lane, Jr. May 1955. 93p. Contract W-7405-eng-48.

Equilibrium data on the four-component system pentaether (dibutoxytetraethylene glycol)-uranyl nitrate-nitric acid-water are presented. From these data, equations and graphical correlations have been developed which express the activities or effective activities of nitric acid and uranyl nitrate in the organic and aqueous phases as functions of their molar concentrations. When these activity relations are utilized, a general method is outlined for calculating the number and height of transfer units in continuous countercurrent extraction columns. The method may be applied to systems consisting of two immiscible phases and two or more transferring components, both present in sufficient concentration to affect the equilibrium, and to systems with one diffusing component that deviate appreciably from ideal-solution behavior. The extraction characteristics of the four-component system have been tested in a continuous countercurrent pulse column, one inch in diameter and five feet high. When uranyl nitrate is extracted into pentaether from aqueous acid solutions, uranium recovery is limited by the

column height to 85%; however, when uranyl nitrate is re-extracted from pentaether into nitric acid, uranium recovery approaches 99.9%. A numerical interpretation is given for these results. (auth)

5934 WADC-TR-55-30(Pt.1)

Pennsylvania State Univ., University Park. Petroleum Refining Lab.

FLUIDS, LUBRICANTS, FUELS AND RELATED MATERIALS. [SUMMARY REPORT FOR OCTOBER 1, 1951 TO SEPTEMBER 30, 1952]. Merrell R. Fenske. Mar. 1955. 209p. Contract AF33(038)-18193.

5935

INSULATING SEAL FOR HIGH-PRESSURE EQUIPMENT. (National Bureau of Standards). J. Franklin Inst. **260**, 51-2 (1955) July.

AEROSOLS

5936 UR-377

Rochester, N. Y. Univ. Atomic Energy Project. AN IMPROVED AEROSOL GENERATOR. K. E. Lauterbach, A. D. Hayes, and M. A. Coelho. Nov. 23, 1954. 16p. Contract W-7401-eng-49.

An aerosol generator has been developed for production of heterogeneous aerosols from either suspensions of ground insoluble materials or solutions of soluble compounds. It has been operated for extended periods of time with only minor fluctuations in mass concentration output. Particle size and concentration of the aerosol have been related to the concentration of soluble material in the aspirated solution. Aerosols formed by the generator are in use for inhalation exposure studies, in theoretical investigations of aerosol behavior and in radioactive particulate studies. (auth)

HEAT TRANSFER AND FLUID FLOW

5937 AD-33957

Columbia Univ., New York
LAMINAR FLOW THRU GRANULAR MEDIA. TECHNICAL REPORT NO. 2. S. Tsakonas and R. Skalak. 1953. 48p. Contract NONR-266(10). (CU-2-53-ONR-266(10)-CE).

An attempt is made to give a unified discussion of various theories of flow through granular media and to evaluate the variation of the permeability with the porosity of the media. The discussion is based on experimental and theoretical studies as well as on a literature survey. The variation of the permeability with porosity in the various theories is put in a standard form involving a porosity function, and although the variation of permeability with porosity is well defined, all of the theories involve at least one empirical constant so that the determination of the permeability is semi-empirical. No exact results, such as solutions of the Navier-Stokes equations, are available even for media of uniform particles regularly arranged. Dimensional analysis plus the assumption of Darcy's law reveals that the permeability varies as the square of the particle size, inversely with the kinematic viscosity of the fluid, and also on a dimensionless function of porosity, shape, and arrangement. The Fair and Hatch formula for the porosity function gave the best agreement with experimental results. (ASTIA abst.)

5938 NGTE-M-178

Gt. Brit. National Gas Turbine Establishment, Farnborough, Hants, England.

SOME EXPERIMENTS ON THE MEASUREMENT OF AIR FLOW BY TRAVERSING A DUCT. H. A. Knight. Nov. 1953. 51p. (AD-34672)

Very little published work exists on practical measurements concerning air flow. This memorandum summarizes the various experiments undertaken in an attempt to obtain a reliable aerodynamic calibrating technique in a measuring duct. The final result was only partly successful and the method has been postponed while an alternative is tried. The tests resulted from attempts to reduce errors as they were discovered and were not a planned experiment. The principal source of inaccuracy with the original method was the static pressure variation across the measuring plane. This variation was not removed although it was reduced to a minimum by correcting the static wall taps and removing swirl generated by a gate valve upstream of a radius bend. An air flow meter calibrated by the section in its original form (total pressure traverse only) would have an error of at least 1%. The accuracy of the calibrating section with modified traversing gear is comparable with a B.S. orifice plate. Probable causes for the static pressure variation are given and features of the experiments which are applicable to general flow measurements are limited. Three untried improvements are suggested. (auth)

5939

KNUDSEN FLOW THROUGH A CIRCULAR CAPILLARY. W. C. DeMarcus and E. H. Hopper (Carbide and Carbon Chemicals Co., Oak Ridge, Tenn.). J. Chem Phys. **23**, 1344-5(1955) July.

An equation is derived for the problem of Knudsen flow through a circular capillary. Solutions of this equation are compared with Clausius's values (Physica **9**, 65 (1929)). (C.W.H.)

5940

INVESTIGATION ON THE EFFECT OF VELOCITY OF FLOW OF WATER ON THE HEAT TRANSFER COEFFICIENT DURING BOILING IN INCLINED TUBES. F. F. Bogdanov (Laboratory of Thermodynamics, Energy Inst., Moscow). Izvest. Akad. Nauk S.S.S.R. Otdel. Tekh. Nauk, No. 4, 136-40(1955) Apr. (In Russian)

5941

FLOW OF VISCOUS GAS IN CYLINDRICAL TUBES WITH HEAT EXCHANGE IN THE REGION OF A SHARP CONstriction. S. V. Romanenko. Zhur. Tekh. Fiz. **25**, 1058-68(1955) June. (In Russian)

MATERIALS TESTING

5942 NACA-TM-1390

ON THE MECHANISM OF BUCKLING OF A CIRCULAR CYLINDRICAL SHELL UNDER AXIAL COMPRESSION. Y. Yoshimura. Translated by Y. Yoshimura and edited by Y. C. Fung and E. E. Sechler. [1951?]. 46p.

The present paper deals with the buckling of a circular cylindrical shell under axial compression from the viewpoint of energy and the characteristics of deformation. It is shown first, both theoretically and experimentally, that the reason why the buckling of a cylindrical shell is quite different from that of a flat plate is attributable to the existence of a nearly developable surface far apart from the

original cylindrical surface, which is equivalent to the existence of an approximately inextensional finite deformation. Based upon this result, the experimental fact that the buckling is really not general but local, that is, that the buckled region is limited axially to a range of 1.5 times the wave length of the lobe, is explained by the theoretical result that the minimum buckling load is smaller in the local buckling than in the general buckling case. The occurrence of local buckling is affirmed also from the viewpoint of the energy barrier to be jumped over during buckling, and from a comparison of the theoretical post-buckling state with the experimental results. Finally, the local buckling with the load applied by a spring is analyzed, and it is proved that the minimum buckling load increases with an increase of rigidity of the spring. (NACA abst.)

TRACER APPLICATIONS

5943

QUANTITATIVE DETERMINATION OF WEAR OF MACHINE COMPONENTS BY RADIOACTIVE INDICATOR METHODS. Yu. S. Zaslavskii and G. I. Shor (Moscow). *Izvest. Akad. Nauk S.S.S.R. Otdel. Tekh. Nauk*, No. 4, 43-52 (1955) Apr. (In Russian)

Experimental apparatus and techniques are described. 8 figures. 15 references. (G.Y.)

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

5944 AECU-3053

Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes.

AUTOMATIC THERMOGRAVIMETRIC ANALYSIS IN CERAMICS. TECHNICAL REPORT NO. XIX. Edmond P. Hyatt, Ivan B. Cutler, W. Martin Fassell, Jr., and Milton E. Wadsworth. May 1, 1955. 16p. Contract AT(11-1)-82.

The design and operating characteristics of an automatic thermogravimetric apparatus for research in ceramics are described. Results of a clay analysis are reported. (C.W.H.)

5945 AEC-tr-2184

MUTUAL SOLUBILITY OF REFRACTORY METAL CARBIDES. L. P. Malkov and I. V. Victor. Translated by F. L. Yaggee from *Vestnik Metalloprom*. 16, 75-82(1936). 15p.

The metal carbide systems discussed include almost all combinations of the basic constituents of hard alloys that have appeared on the market. The alloys indicated were obtained in the treatment of metals, as by drawing and drilling operations, being carried out in a series of technical fields (wire drawing, stamping, etc.). This investigation shows that the indicated alloys contained carbides as solid solutions in one another and not as mechanical mixtures. The lattice of the soluble components (carbides) does not disappear completely in all of the alloys. These investigations have shown that the WC lattice is preserved, indicating the presence of an excess of WC. In practice such alloys also prove themselves to have high mechanical properties. When mixed with metals of the iron group (Co or Ni) the complex

carbides yield alloys having high mechanical properties (toughness and hardness), at the expense of partial solubility of these carbides in the metals of the iron group. This solubility is accompanied by a corresponding improvement of the complex carbide in the soluble carbide. An entire series of new combinations of carbides which can be used for the preparation of entirely new, hard alloys is tabulated. (auth)

5946

REMARKS ON THE VARIATION OF THE RESISTIVITY AS A FUNCTION OF TEMPERATURE OF CERAMICS WITH A MANGANESE AND NICKEL OXIDE BASE. J. Suchet. *J. phys. radium* 16, 417-22(1955) May. (In French)

The resistivity of ceramics of oxides of manganese and nickel presents an anomaly to Wilson's Law. Study of preparation conditions of these ceramics shows that this anomaly is very sensitive to fritting conditions. The author proposes a ceramic model with a superficial layer which takes account of the obtained results and whose extension to other types of ceramics does not run into any contradiction with previous works. (tr-auth)

CORROSION

5947 EES-040038F(10)

Naval Engineering Experiment Station, Annapolis. EXAMINATION OF SPECIAL TUBE JOINTS FROM A STAINLESS STEEL AUXILIARY MINE-SWEEPER BOILER. W. Lee Williams. Oct. 22, 1954. 17p.

This report is the sixth in a series on the problem of cracking in nonmagnetic auxiliary mine-sweeper boilers. It covers an examination for stress-corrosion cracks at the header joints of two tubes removed from a stainless steel Cyclotherm boiler after steaming for 1574 hours. One tube had been seal welded from the waterside to prevent entry of water in the tube-to-header crevice. The other tube had been plugged and water cooled at the ends to prevent flashing to steam of water which entered the tube-to-header crevice. No stress-corrosion cracks were found in these joints. (auth)

GEOLOGY AND MINERALOGY

5948 RME-3020

Minnesota. Univ., Minneapolis. ANNUAL REPORT FOR APRIL 1, 1954 TO MARCH 31, 1955. John W. Gruner and Deane K. Smith, Jr. Apr. 1, 1955. 37p. Contract AT(30-1)-610.

A comparison of four widely scattered important deposits in Utah, Wyo., and N. Mex., and Chinle Formations, shows the great similarity of the processes that were at work in them. Not only are the chemical reactions that precipitated the U almost identical but also the immediate geological settings are as similar as can ever be hoped for in deposits of this type. All criteria generally invoked in the search for favorable localities are contained in these four areas. The problem of the composition and structure of coffinite is discussed and agreement seems to have been reached among the several investigators. The conditions of its formation and why it is the most important black ore mineral in some areas while in others uraninite is the only one that has been found are not known. Temperature does not seem to be a factor. The U mineral determinations and occurrences in Wyoming and northern Colorado have been tabulated chiefly for those working in

these regions and because they afford a good comparison with other areas and tell what to expect in future developments. Additional mineral determinations for the Colorado Plateau region are also included. Attention is called to the U-silicate, soddyite, at the Jack Pile Mine near Laguna, New Mexico. This is the first occurrence in sedimentary rocks. (auth)

5949 AEC-tr-2186

DETERMINATION OF THE GEOLOGICAL AGE OF TWO STONE METEORITES BY THE ARGON METHOD. E. K. Gerling and T. G. Pavlova. Translated by V. N. Rimsky-Korsakoff from *Doklady Akad. Nauk S.S.S.R.* **77**, 85-6(1951). 4p.

The geological age of two chondrite-type meteorites was determined by the argon method based on the K-capture decay of K^{40} . Results are tabulated, and the ages are determined to be 3.03×10^8 and 3.00×10^8 years. (B.J.H.)

5950

ISOTOPE GEOLOGY. Kalervo Rankama. New York, McGraw-Hill Book Co., Inc., 1954. 535p.

The influence of the nuclides on geology and their possible applications to problems of geology are the central theme of this book. The physics and chemistry of the nuclides are thoroughly reviewed and the natural science of nuclides are discussed. An extensive bibliography, and subject and author indexes are included. The great possibilities of the use of isotopes, both the ones used extensively and others which have not as yet been thoroughly investigated, in geology studies are stressed. (B.J.H.)

5951

MONOCLINES OF THE COLORADO PLATEAU. Vincent C. Kelley. *Bull. Geol. Soc. Amer.* **66**, 789-804(1955) July.

In the Colorado Plateau monoclines have an aggregate length of nearly 2500 miles, and the greatest nearly uninterrupted monocline is about 300 miles long. Every gradation from gentle open monoclines to overturned and thrust structures is present on the Plateau. Reversal of dip, either broad or locally abrupt, is common near the head or foot of the monoclines; however, the monoclinical designation should be retained on a regional basis. There is homology between monoclines and noses, anticlines, synclines, normal faults, and reverse faults. The monoclines are thought to be tangentially compressive Laramide features, and in places they show pronounced coupling action. They are divided into a western group that may be genetically related to the Central Laramide Rockies and an eastern group related to the Eastern Laramide Rockies. Roughly dividing the two groups are the Uinta and San Juan basins and the Salt fold and fault belt of the Paradox basin. (auth)

METALS AND METALLURGY

5952 AD-35265

Michigan. Univ., Ann Arbor. Engineering Research Inst.

DEVELOPMENT OF PROCEDURES FOR THE IDENTIFICATION OF MINOR PHASES IN HEAT-RESISTANT ALLOYS BY ELECTRON DIFFRACTION. PROGRESS REPORT NO. 9 FOR THE PERIOD JANUARY 15 TO APRIL 15, 1954. L. O. Brockway and W. C. Bigelow. 16p. Contract AF33(616)-23.

Electron-diffraction and x-ray-diffraction studies of specimens of Inconel-X alloy aged for periods up to 1000

hours at 1200°, 1400°, and 1600°F have been made. Columbium carbonitride, titanium nitride and a complex $M_{23}C_6$ -type carbide have been identified in the specimens aged at 1200° and 1400°F while only the columbium carbonitride and the titanium nitride were found in the specimens aged at 1600°F. Preliminary studies have also identified an intermetallic γ' phase in the specimen aged 1000 hours at 1400°F. Resent results have also provided additional evidence for the occurrence of an Fe_2W phase in N-155 alloy. (See also AD-26,730) (auth)

5953 AD-35289

Battelle Memorial Inst., Columbus, Ohio.

A METALLURGICAL STUDY OF MOLYBDENUM. QUARTERLY STATUS REPORT NO. 18 COVERING THE PERIOD NOVEMBER 1, 1953 TO JANUARY 31, 1954. Jan. 31, 1954. 23p. Contract N9onr-82100, T. O. 1.

Various additions to Mo and Mo-Th alloys were tested in an effort to improve ductility. Welding tests were carried out on Mo ingots containing about 1% Ti in an effort to make the weld and surrounding area ductile at room temperature; the forging of these ingots is described. The effect of heat treatment on the ductility of solid-state purified Mo wire was further investigated, especially toward determining the critical temperature zone. A tantalum heater element used in the heat-treating furnace and an atmosphere of H_2 did not noticeably improve Mo ductility. (L.M.T.)

5954 AECU-3022

Los Alamos Scientific Lab., N. Mex.

THE SOLUBILITY OF BERYLLIUM IN LIQUID GALLIUM, TIN AND INDIUM, AND THE PHASE DIAGRAMS OF BERYLLIUM WITH THESE METALS. Reed O. Elliott and Eugene M. Cramer. [1955?]. 10p. [W-7405-eng-36].

The solubilities of beryllium in liquid gallium, tin and indium have been determined throughout the temperature range 540 to 1200°C. Further data were obtained in order to establish the nature of the binary phase diagrams of beryllium with gallium, tin and indium. All three diagrams are characterized by a wide miscibility gap in the liquid state, an absence of intermediate phases, and no detectable solid-state solubility. A monotectic was found in the beryllium-Gallium system. No evidence for a eutectic was found in any of the systems. (auth)

5955 AECU-3055

Commonwealth Engineering Co. of Ohio, Dayton, Ohio. GAS PLATED COATINGS ON METALS AND ALLOYS. PROGRESS REPORT NO. 1. Mar. 11, 1953. 17p. For Oak Ridge National Lab. Contract W-7405-eng-26, Subcontract No. 526.

The deposition of chromium and chromium-nickel coatings on copper by the gas plating method was studied. Block diagrams are given of the system. (B.J.H.)

5956 ISC-595

Ames Lab., Ames, Iowa.

ZIRCONIUM-GERMANIUM ALLOY SYSTEM. O. N. Carlson, P. E. Armstrong, and H. A. Wilhelm. Apr. 11, 1955. 26p. Contract W-7405-eng-82.

The zirconium-germanium system has been investigated by microscopic, thermal and x-ray methods. Four intermediate phases, Zr_3Ge , Zr_2Ge_3 , $ZrGe$ and $ZrGe_2$ have been proposed on the basis of microstructures and x-ray data. Zr_3Ge undergoes a peritectic transformation at 1585°C (2885°F), $ZrGe$ at 2240°C (4064°F) and $ZrGe_2$ at 1520°C

(2768°F). Zr_3Ge_2 melts congruently at approximately 2300°C (4172°F). There is a eutectic at 1535°C (2795°F) at the composition 7.7 weight per cent germanium. There is limited solid solubility of germanium in zirconium and negligible solid solubility of zirconium in germanium. (auth)

5957 MR-556

Frankford Arsenal. Pitman-Dunn Labs., Philadelphia. SURVEY OF THE LITERATURE ON SODIUM MODIFICATION OF ALUMINUM-SILICON-MAGNESIUM ALLOYS. R. C. Harris. [Feb. 1954]. 14p. (AD-29824)

An extensive survey of the literature has been made. Several methods for the addition of sodium to the melts are presented along with information regarding the amount of sodium required to produce modification. The effects of sodium on the microstructure and mechanical properties of aluminum-silicon alloys are described. From the work done on the subject several theories to account for the microstructural changes have been developed. These theories are presented and their inadequacies pointed out. Most of the information in the literature deals with modification of hypereutectic aluminum-silicon alloys. This is presented in the belief that the data can be applied to alloys of silicon content which approach that of commercial 356 alloy. No direct information has been found on the subject of modification of the ternary aluminum-silicon-magnesium alloys. (auth)

5958 MRL-5

Watertown Arsenal. Materials Research Lab., Mass. A PRELIMINARY EXAMINATION OF THE QUENCHING OF TITANIUM ALLOYS. Leonard D. Jaffee. Apr. 1955. 19p.

From the limited experimental data in the literature, preliminary values were derived for the thermal diffusivity of titanium alloys and for the quenching severity of various mediums used in heat treating them. The thermal diffusivity, under quenching conditions, was found to be approximately 0.006 in.²/sec. The quenching severity, H, for brine is approximately 8, for water 4, for oil 0.9, for air 0.08, and for argon 0.02 in.⁻¹. The quenching severity of the Jominy-Boegehold end-quench water-jet against titanium alloys appeared effectively infinite. Using these results, graphs were prepared showing ideal round sizes and Jominy positions having cooling conditions equivalent to those at the center and surface of titanium alloy rounds, plates and sheets quenched in various media. (auth)

5959 NAA-SR-262

North American Aviation, Inc., Downey, Calif. EFFECTS OF FISSION FRAGMENTS ON RADIATION DAMAGED METALS. J. A. Brinkman and W. S. Gilbert. July 31, 1953. Decl. May 9, 1955. 34p. Contract AT-11-1-GEN-8.

Thorium metal and Au-3% Th alloy specimens were irradiated with both 9 Mev protons and 18 Mev deuterons. The deuteron irradiation was found to anneal some of the damage produced by the protons and to produce a different type of damage. These effects are interpreted as the result of fission fragments produced by the irradiation of thorium with deuterons. It is believed that the damage annealed by these fission fragments consists of interstitial vacancy pairs, and the damage produced by the fission fragments consists primarily of dislocation loops. (auth)

5960 NACA-RM-L55E12b

Langley Aeronautical Lab., Langley Field, Va. TENSILE PROPERTIES OF SOME SHEET MATERIALS UNDER RAPID-HEATING CONDITIONS. George J. Heimerl and John E. Inge. [Apr. 25, 1955]. 10p.

Results are presented of tests to determine the effect of heating at uniform temperature rates from 0.2 to 100°F per second on the tensile properties of some sheet materials under constant load conditions -7075-T6 (75S-T6) and 2024-T3 (24S-T3) aluminum alloys, Inconel, and RS-120 titanium alloy. Some comparisons are given between yield and rupture stresses obtained under rapid-heating conditions and those obtained from elevated-temperature stress-strain tests for 1/2-hour exposure. Master yield- and rupture-stress curves based on the use of a linear temperature-rate parameter are included which provide a convenient method for predicting yield and rupture stresses and temperatures for different temperature rates. (NACA abst.)

5961 NP-5705

California. Univ., Berkeley. Minerals Research Lab. EFFECT OF ALLOYING AND COLD WORKING ON THE ACTIVATION ENERGY FOR CREEP OF ALUMINUM. O. D. Sherby and P. W. Flynn. June 15, 1955. 19p. Contract N7-onr-295, T. O. II, Technical Report No. 42.

The activation energies for creep of dilute aluminum alloys at elevated temperatures were determined by a technique involving rapid changes in temperature under constant stress. The results revealed that the activation energy for creep is insensitive to dilute solid solution alloying with zinc, cadmium, germanium, magnesium and copper, to dispersion hardening with $CuAl_2$ particles in an Al-Cu alpha solid solution alloy and to cold working. The various activation energies obtained can be contained within the value 34,500 calories per mole plus or minus 3500 calories per mole. (auth)

5962 NP-5709

Illinois. Univ., Urbana. FATIGUE OF DUCTILE METALS AT RANGES OF STRESS EXTENDED TO COMPRESSION. (CIVIL ENGINEERING STUDIES—STRUCTURAL RESEARCH SERIES NO. 104). J. L. Merritt, R. J. Mosborg, and W. H. Munse. July 1, 1955. 112p. Contract N6-ori-71, Task Order V.

Based on the theoretical maximum range of stress in a notched specimen, failure of ASTM-A7 steel in fatigue does not appear to be a function of the true range of stress developed in an unnotched specimen of the same material. A rational revision to the maximum distortion energy theory to explain fatigue failures in compression is not apparent. A variation of fatigue reduction factor with range ratio seems indicated but the variation is not consistent for different materials or perhaps for different test conditions. Unnotched fatigue specimens of steel may behave differently than similar aluminum alloy specimens especially at fatigue ranges of high tension to greater tension. Constant strain conditions approximating constant load conditions may not be comparable to constant load conditions of fatigue testing. Static work hardening in compression appears to be comparable to the first few cycles of fatigue stress provided the maximum fatigue stress is approximately equal to the stress attained during the work hardening. Under fatigue conditions of constant load in the tension to greater tension range the failures

resemble general yielding rather than the brittle fracture characteristic of fatigue. Straight line constant life contours plotted on modified Goodman coordinates have a constant slope, within reasonable limits, of 0.700 for notched specimens of annealed ASTM-A7 steel, 24S-T3 and 75S-T6 aluminum alloys, and normalized 4130 steel. For the last three materials however, the stress ranges include no tests predominately in compression. The corresponding slope for unnotched specimens of the same materials is 0.500, but the error for annealed ASTM-A7 steel is large since the experimental contours for this material deviate considerably from a straight line. The S-N curves for notched specimens of the four materials reported have a constant slope, within reasonable limits, of 0.115 between 1×10^5 and 2×10^6 cycles. A fatigue reduction or stress concentration factor whose magnitude is a function of the material seems indicated for unnotched specimens. (auth)

5963 NRL-4564

Naval Research Lab., Washington, D. C.
CHARACTERISTICS OF THE BAINITE TRANSFORMATION IN A Ni-Cr STEEL. L. S. Birks. June 2, 1955. 10p.

The bainite transformation in a 3.5% Ni, 1.25% Cr steel was studied under various conditions of cooling and stress. Several characteristics may be specified: (1) Transformation in the bainite region (920 to 575°F) is very little affected by the manner of cooling from the austenitizing temperature, 1600°F, to the upper limit of bainite transformation, 925°F. (2) Starting time for the bainite transformation is the same order of magnitude for either isothermal conditions or continuous cooling, but the rate of transformation is somewhat greater for isothermal transformation. (3) Tensile stress accelerates both isothermal and continuous-cooling transformation, and 32,000-psi stress changes the form of the isothermal transformation diagram to correspond in appearance to the continuous-cooling diagram. (4) Transformation for nonlinear continuous cooling may not be determined directly from the linear continuous-cooling transformation diagram but may be predicted by first assuming that the fractional amount of austenite transformed in a given small temperature interval depends on the approximate linear cooling rate during that temperature interval, and second, summing stepwise over the whole temperature range. (auth)

5964 WAL-401/203-4

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

DEVELOPMENT OF TITANIUM-BASE ALLOYS OF HIGH STRENGTH AND TOUGHNESS. INTERIM TECHNICAL REPORT NO. 3 [FOR] MAY 1, 1954-AUGUST 31, 1954. C. R. Lillie and D. J. McPherson. Mar. 4, 1955. 23p. Contract DA-11-022-ORD-1428.

Progress is reported in the development of Ti-base alloys of high strength and toughness with emphasis of a strength range of 75,000 to 200,000 psi. Data are included on hot rolling conditions and chemical analysis of Ti-Al-V alloys; hot rolling conditions and chemical analysis of Ti-Al-Cr alloys; hot rolling conditions for Ti-Al-Mo and Ti-Al-Fe alloys; forging temperatures and chemical analysis of quaternary alloys with Si; final forging temperatures and chemical analysis of alloys with B; $\beta/\alpha + \beta$ transformation temperatures of various Ti-Al alloys; the tensile properties of various Ti-Al alloys in the as-rolled or as-forged condition; and a comparison of

the mechanical properties of various Ti-Al alloys after heat treatment. (For preceding period see WAL-401/203-3.) (C.H.)

5965 AEC-tr-2192

COMPENSATION FOR THE ERRORS IN MEASUREMENT IN THE DRILLING PROCESS BY G. SACHS IN ORDER TO DETECT INNER STRESSES IN RODS AND PIPES. H. Bühler and W. Schreiber. Translated by K. S. Bevis from *Metall.* 5, 53-7(1951). 12p.

5966 AERE-Lib/Trans-516

A STUDY OF THE ANNEALING OF ROLLED URANIUM. G. Cabane and J. Petit. Translated by F. Hudswell from *Rev. mét.* 51, 603-13(1954). 13p.

5967

EFFECT OF TEMPERATURE ON DUCTILITY AND RESISTANCE TO DEFORMATION OF COMMERCIAL TITANIUM. E. M. Savitskii and M. A. Tylkina (Moscow). *Izvest. Akad. Nauk S.S.S.R. Otdel. Tekh. Nauk*, No. 4, 53-7 (1955) Apr. (In Russian)

5968

ZIRCONIUM METAL. H. L. Gilbert and C. Q. Morrison (U. S. Bureau of Mines, Albany, Oregon). *Chem. Eng. Progr.* 51, 320-5(1955) July.

The mechanism of the reaction of Mg and Zr Cl_4 has been studied on an operational scale. Variations and modifications which have been incorporated in Kroll process for the production of zirconium are discussed. (C.W.H.)

5969

SLIP CASTING THORIUM DIOXIDE. P. D. S. St. Pierre (Dept. of Mines and Technical Survey, Ottawa, Ontario, Canada). *Am. Ceram. Soc. Bull.* 34, 231-2(1955) July.

An effective and economical method for casting thorium is described. The use of polyvinyl alcohol was found to overcome completely the difficulties caused by unstable slip and fragile green ware. (auth)

5970

ELECTRON DIFFRACTION STUDY ON TITANIUM ATTACKED BY VARIOUS ACIDS. Shiro Ogawa and Denjiro Watanabe. *Science Repts. Research Insts. Tohoku Univ., Ser. A* 7, 184-93(1955) Apr.

Titanium immersed in various acids were examined by electron diffraction. Surfaces attacked by hydrofluoric, hydrochloric, sulfuric or phosphoric acid suffered considerable corrosion and yielded Debye rings of a face-centered cubic lattice, which was deduced as belonging to titanium hydride (TiH_2) formed in the course of corrosion. At the surfaces immersed in nitric acid at room temperature for a long period, however, hexagonal rings of titanium alone were observed, and these surfaces were taken as the standard for further corrosion tests. In the following cases the surfaces became passive, and protective films were formed: When the specimens were attacked by boiling nitric acid or aqua regia, anatase was formed, while a mixture of this and a rutile was seen after immersion in boiling 10% solution of chromic acid. The surfaces immersed in boiling 10% solution of ferric chloride for 1 hour yielded many sharp rings, which, however, could not be assigned to any known compound of titanium at the present stage. (auth)

5971

EXAMINATION OF MICROSTRUCTURES UNDER VARYING STRESS. Richard A. Flinn and Paul K. Trojan (Univ. of Michigan, Ann Arbor). *Metal Progr.* 68, No. 1, 88-9(1955) July.

A bend test apparatus is described which permits continuous microscopic examination of metal specimens while being loaded to fracture. (auth)

5972

PROPERTIES OF ARC-CAST MOLYBDENUM. Norman L. Deuble (Climax Molybdenum Co., New York). Metal Progr. 68, No. 1, 105-10(1955) July.

The outstanding strength of Mo-base alloys compared with other alloys at elevated temperatures is emphasized. The creep strength far exceeds that of other metals and alloys at temperatures above 1600°F. (J.E.D.)

5973

EFFECT OF NEUTRON RADIATION ON ALUMINUM ALLOYS. R. V. Steele (Univ. of California, Livermore) and W. P. Wallace (Hanford Atomic Operations, Richland, Wash.). Metal Progr. 68, No. 1, 114-15(1955) July.

The tensile strength and yield strength of aluminum alloys were increased by neutron irradiation. Ductility of annealed samples was decreased but not as much as if the same increase in strength had been obtained by heat treatment or mechanical means. (auth)

5974

PRESSURE WELDING GIVES STRONGER TITANIUM JOINTS. A. P. Lage and S. S. Smith, Jr. (Menasco Mfg. Co., Burbank, Calif.). Iron Age 176, No. 2, 103-5(1955) July 14.

Pressure welding provides a reliable method of fabricating 3Al-5Cr titanium alloy. The method produces a forged butt weld of superior strength by upsetting the faying surfaces under heat and pressure. Hot working during welding improves weld strength without changing the basic character of the alloy's grain structure. Success with the method has led to continued development of the process for other titanium alloys. (auth)

5975

WELDING AT BRITISH ATOMIC PLANTS. Atomics 6, 202-4(1955) July.

A general discussion of the argon-arc welding method used in construction of British atomic factories is given. (B.J.H.)

PHYSICS

5976 WCRT-TN-54-32

Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio.

DESIGN FOR KILO-CURIE GAMMA FACILITY. William N. Lorentz. Feb. 17, 1954. 7p. (AD-28049)

A study was conducted on the planning and designing of a kilocurie γ irradiation facility which would meet the requirements of the Analysis and Measurement Branch. Engineering studies planned for the facility include radiation damage, γ dosimetry, nondestructive irradiation of materials, and shielding. The facility will be a flexible but safe installation for performing both in-air and in-water γ irradiation. Provision will also be made for a 12- \times 12-ft chamber for in-air irradiations and a 3-ft-diam, 12-ft-deep water well for in-water irradiations. (ASTIA abst.)

5977

MEASUREMENT OF THE CHAPMAN-JOUGUET PRESSURE AND REACTION ZONE LENGTH IN A DETONATING HIGH EXPLOSIVE. Russell E. Duff and Edwin Houston (Los

Alamos Scientific Lab., N. Mex.). J. Chem. Phys. 23, 1268-73(1955) July.

The Chapman-Jouguet pressure and the reaction zone length in detonating Composition B containing 63% RDX at a density of 1.67 g/cm³ have been measured by determining the initial free surface velocity imparted to aluminum plates as a function of plate thickness. The C-J pressure is 0.272 megabar and the reaction zone length is 0.13 mm. The experimental free surface velocity-plate thickness curve provides powerful confirmation for the pressure profile in a detonating explosive predicted by the hydrodynamic theory of detonation proposed by Zeldovich, von Neumann, and Doring. (auth)

5978

ON THE HEAT OF DISSOCIATION OF N₂. John F. Burns (Carbide and Carbon Chemicals Co., Oak Ridge, Tenn.). J. Chem. Phys. 23, 1347(1955) July.

It is concluded from an investigation of the structures of the ionization efficiency curves for the N⁺ ion from N₂ that both the atom and ion resulting from the dissociation of N₂ under electron impact are initially formed in their ground states and that upward breaks are observed at 1.9 and 2.4 ev. (C.W.H.)

COSMIC RADIATION

5979 NP-5707

Minnesota. Univ., Minneapolis.

THE HEAVY PRIMARY COSMIC RADIATION AT A GEOMAGNETIC LATITUDE OF 10 DEGREES NORTH (thesis). Robert E. Danielson. June 1955. 72p. Contract N6onr-246.

Three main questions are discussed fully: the azimuthal asymmetry of the heavy component of cosmic radiation at the equator; the primary flux of the heavy component at the equator; and the determination of the Z spectrum at the equator. Designs and circuit diagrams for the apparatus are shown. All mechanisms and emulsions were contained in an aluminum sphere which was flown by balloon to gather data. Data, calculations, and graphs are given on the Z spectrum, radiation intensity and mean free paths, and asymmetries of radiations. The approximate abundances of C, N, and O show C:N:O = 3:2:1 and it also appeared that some boron and beryllium were present though they may have been fragments rather than primaries. The observed azimuthal asymmetries are not in agreement with theoretical predictions, which is interpreted as anisotropy of the primaries. Primary fluxes are also given. (B.J.H.)

5980 UCRL-Trans-232(L)

MEASUREMENT OF MASS BY IMPULSE AND IONIZATION, AND SPECTRA OF IMPULSES OF DIFFERENT PARTICLES OF COSMIC RADIATION AT SEA LEVEL. V. A. Lyubimov, G. P. Eliseev, and V. K. Kosmachevskii. Translated by S. Shewchuck from Doklady Akad. Nauk S.S.S.R. 102, 57-60(1955). 9p.

An abstract of this report appears in Nuclear Science Abstracts as NSA 9-5393.

5981

ON THE DIURNAL VARIATIONS OF AUGER SHOWERS IN SOLAR TIME AND IN SIDEREAL TIME. Pierre Auger, André Cachon, Alice Daudin, André Freon, and Claude Moszkowski. Compt. rend. 240, 2407-9(1955) June 20 (In French)

The diurnal variations of Auger showers have been studied as a function of sidereal and of solar time. The results are tabulated, and it is concluded that the diurnal variation in solar time is of atmospheric origin and that the data also gives an argument in favor of the galactic origin of the sidereal variation. (B.J.H.)

5982

COSMIC-RAY INTENSITY ABOVE THE ATMOSPHERE AT HIGH LATITUDES. L. H. Meredith, J. A. Van Allen, and M. B. Gottlieb (State Univ. of Iowa, Iowa City). *Phys. Rev.* **99**, 198-209(1955) July 1.

The total charged particle cosmic-ray intensity above the atmosphere has been measured with thin-walled Geiger counters (total effective stopping power of apparatus and residual atmosphere 0.5 g/cm² of aluminum) carried in balloon-launched rockets at geomagnetic latitudes 54.3° N, 62.1° N, 71.9° N, and 86.7° N. The respective values of unidirectional particle intensity averaged over the upper hemisphere are: $\bar{J} = 0.44 \pm 0.01$, $\leq 0.50 \pm 0.05$, $\leq 0.50 \pm 0.05$, and $= 0.48 \pm 0.01$ (cm² sec sterad)⁻¹. These results are consistent with the complete or nearly complete absence of primary cosmic rays having a magnetic rigidity less than 1.7×10^9 volts. (auth)

5983

HYDROMAGNETIC WAVES AND THE ACCELERATION OF COSMIC RAYS. Eugene N. Parker (Univ. of Utah, Salt Lake City). *Phys. Rev.* **99**, 241-53(1955) July 1.

The large amounts of energy necessary for the acceleration of cosmic rays throughout the galaxy introduces a serious transport problem. The hydrodynamic and hydromagnetic equations are investigated from the viewpoint of energy propagation. It is shown that, with the galactic model of Fermi and Chandrasekhar, the observed motions of the interstellar gas reduce to hydromagnetic waves, which are, as it turns out, the most effective means of energy transport. A consideration of the interaction of charged particles with hydromagnetic waves shows that it is the fluid velocity, and not the wave velocity, that is responsible for the acceleration of cosmic rays by Fermi's mechanism. We calculate the dissipation of hydromagnetic waves in the interstellar medium, and the variation of amplitude and wave length of such waves with changes in density and large-scale field intensity. It is then shown that the galaxy is no more than one percent efficient in the acceleration of cosmic rays because of the tremendous viscous losses in the interstellar medium, and that there is no hydromagnetic mechanism that can convert the observed large-scale low-velocity fluctuations in the interstellar medium to the required small-scale high-velocity motions. (auth)

5984

ON RELATIVISTIC PARTICLES IN HIGH ENERGY SHOWERS. Rama (Tata Inst. of Fundamental Research, Bombay, India). *Proc. Indian Acad. Sci.* **39A**, 162-4(1954).

Seventy-nine high-energy showers were investigated to determine the interaction cross section for shower particles in emulsion and the ratio of neutral π mesons to charged shower particles. Data are tabulated along with those of previous work. It is concluded that less than 18% of shower particles are neither π mesons or protons, providing the proper assumptions are made. (B.J.H.)

5985

LVI. NOTES ON THE ENERGY SPECTRA AND FREQUENCIES OF PRODUCTION OF V^0 -PARTICLES. D. B. Gayther (Univ., Manchester, England). C. C. Butler (Imperial Coll.,

London, England). *Phil. Mag.*, (7), **46**, 467-81(1955) May.

An analysis is made of the decays of 45 V^0 -particles associated with nuclear interactions in a lead plate mounted inside a cloud chamber. Data are given on the energy spectra of the Λ^0 and θ^0 particles and possible sources of experimental bias are discussed. Distributions are also given of ϕ , the angle between the path of the primary of the interaction in which a V^0 particle is produced and the line of flight of the V^0 -particle in the laboratory frame of reference. The ϕ -distribution for Λ^0 particles is found to be similar to that of the grey particles produced in nuclear interactions while that for the θ^0 -particles is similar to the angular distribution of the shower particles. Both Λ^0 and θ^0 particles are found to occur at frequencies of about 3-0% of the charged π mesons in nuclear interactions of mean energy (5 to 10) Bev. A discussion is given of the data in terms of possible modes of production. (auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

5986 NYO-7047

Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.

TEMPERATURE-DIFFUSE SCATTERING FOR POWDER PATTERNS FROM CUBIC CRYSTALS. TECHNICAL REPORT NO. 22, SCOPE II. F. H. Herbstein and B. L. Averbach. June 24, 1955. 7p. Contract AT(30-1)-1002.

Warren (*Acta Cryst.*, **6** 803(1953)) showed that a better approximation of the contribution of temperature-diffuse scattering is obtained if it is assumed that the velocities of the elastic waves in the lattice are all equal. Since Warren's derivation was valid at high temperatures only, concern is made in this paper with obtaining an expression which is valid at all temperatures. (L.M.T.)

ELECTRICAL DISCHARGE

5987 AECU-3052

Utah, Univ., Salt Lake City. Inst. for the Study of Rate Processes.

FIXATION OF NITROGEN: THE POWER FACTOR. Ransom B. Parlin and Jerome R. Tichy. PROJECT NO. 2, PROGRESS REPORT [FOR] JANUARY 1, 1954 TO JANUARY 1, 1955. Project Title: INDUCTION OF CHEMICAL REACTIONS BY HIGH FREQUENCY ELECTRICAL DISCHARGES IN GASES. Mar. 10, 1955. 16p. Contract AT(11-1)-82.

This work was done in order to determine the pressure dependence of the power factor in connection with the induction of chemical reactions in a high frequency discharge. It was concluded that the power factor, as a function of pressure, goes through a maximum. Data are given in graphical and tabular forms. (B.J.H.)

ELECTRONS

5988

ELECTRON BEAM METHOD OF DETERMINING DENSITY PROFILES ACROSS SHOCK WAVES IN GASES AT LOW DENSITIES. Douglas Venable and Daniel E. Kaplan (Los Alamos Scientific Lab., N. Mex.). *J. Appl. Phys.* **26**, 639-40(1955) May.

The dependence of cathode ray attenuation on gas density has been used to observe the density profiles of shock waves propagating in gases. The system used is described, and oscilloscope traces of the electron beam transmission are shown. (B.J.H.)

5989

SECONDARY ELECTRON EMISSION BY PRIMARY ELECTRONS IN THE ENERGY RANGE OF 20 KILOVOLTS TO 1.3 MEV. Bernard L. Miller (St. Joseph's Coll., Philadelphia, Penna.) and W. C. Porter (Bartol Research Foundation, Swarthmore, Penna.). J. Franklin Inst. **260**, 31-40(1955) July.

A linear electron accelerator was used to provide a beam of 20 kev to 1.3 Mev and the secondary electron emission from Au, Cu, W, Be, Al, and Ag were studied. Preliminary studies were also made on wood, quartz, and lucite. A diagram of the target assembly is given, and graphs showing the electron emission as a function of collector voltage, primary voltage, and atomic number of the target are shown. Data were in qualitative agreement with those of lower-energy experiments. (B.J.H.)

INSTRUMENTS

5990 RDB(W)/TN-206

Gt. Brit. Windscale Works, Sellafield, Cumb., England. A LIQUID METAL LEVEL INDICATOR EMPLOYING GAMMA RADIATION TECHNIQUES. A. P. Dixon. May 1955. 11p.

This memorandum describes a method of locating the level of liquid metal coolant in a stainless steel tank, utilizing the change in count rate obtained from a geiger detector and gamma source arranged on opposite sides of the tank. A servo drive enables the detector-source mounting to follow automatically changes in level, and remote position indicating is employed. (auth)

5991 UCRL-1484(Rev.)

California. Univ., Berkeley. Radiation Lab. 36-INCH CYCLOTRON PHASE SERVO CONTROL SYSTEM. Bob H. Smith. Mar. 1955. 34p. Contract W-7405-eng-48.

Complete details are given on a Servo Phase Control System which will automatically control the phase relationships of the accelerating voltages on the "dees" of the 36-in. cyclotron anywhere from 90° to 150°. Manual control and metering points are also provided. Complete block diagrams, circuit diagrams, and operating procedures are given. (B.J.H.)

5992 WAL-142/59

California Inst. of Tech., Pasadena. DESIGN AND DEVELOPMENT OF AN ELECTRONIC X-RAY PROBE FOR THE STUDY OF ALLOYS AND OF THE STRUCTURE OF METALS. INTERIM TECHNICAL REPORT NO. 1. Jesse W. M. DuMond, Pol Duwez, and David B. Wittry. Feb. 1954. 33p. Contract DA-04-495-Ord-463. (AD-32210)

Progress on the design and development of an electronic x-ray microprobe for quantitative and qualitative composition measurements of about 1 cubic micron of the surface of metals and alloys is described in this report. The principle is that first used by Castaing, in which the metal is subjected to bombardment by a finely focused probe of electrons and the elements present and their proportions are determined by analysis of the frequency and intensity of the characteristic x-rays emitted. With the first model of the instrument, it will be possible to study the elements in the range of atomic numbers 19 through 34 and 50 through 84. This report omits any theoretical treatment of the effects of heat generated in the sample, fluorescence radiation, or a detailed discus-

sion of the corrections that must be made. These matters will be considered in a later report. (auth)

5993

SOME REMARKS ON DATA HANDLING SYSTEMS. R. L. Chase (Brookhaven National Lab., Upton, N. Y.). I.R.E. Trans. Nuclear Sci. **NS-2**, 9-11(1955) June.

Three classes of nuclear data handling problems are discussed, and three output devices are described. These include a card-punching system for a neutron diffraction spectrometer, an electric typewriter system for a large counting room, and a proposed magnetic drum storage system for a time-of-flight analyzer. (auth)

5994

MEASUREMENT OF THE RESOLVING TIME OF SCALING CIRCUITS. P. K. Patwardhan (Tata Institute of Fundamental Research, Apollo Pier Road, Bombay, India). Brit. Inst. Radio. Engrs. **15**, 259-68(1955) May.

An account of the double-pulse method of measurement of the resolving times of some common types of scaling circuits is introduced by an elementary statistical analysis of the random processes met in radiation counting. Other possible methods of measurement are also mentioned. The influence of circuit parameters on resolving time is pointed out, and the scope for further improvement is indicated. (auth)

5995

FAST COUNTER CIRCUITS WITH DECADE SCALER TUBES. E. J. van Barneveld. Philips Tech. Rev. **16**, 360-70(1955) June.

The EIT scaler tube is a decade scaler within very small compass—a tube no larger than an ordinary radio valve. It has the further advantages of direct reading (the number counted appears as an illuminated spot opposite the digit on the tube) and a high counting rate when used with a suitable input circuit. Suitable circuits, together with the counting rates actually attained by them during laboratory tests, are discussed. In particular, the counting of random pulses is considered. (auth)

ISOTOPES

5996

ADVANCES IN ATOMIC PROBLEMS DURING 1954. Ion **15**, 253-66; 271(1955) May. (In Spanish)

The Spanish radioisotope program is discussed fully in rather general terms. Particular attention is given to the process of producing isotopes, the economic aspects of production, chemical, physical, and biological applications of radioisotopes, and the transport and handling of the isotopes. (B.J.H.)

MASS SPECTROGRAPHY

5997

USE OF A MASS SPECTROMETER WITH A NONHOMOGENEOUS MAGNETIC FIELD FOR DETERMINING ATOMIC MASSES. A. V. Dubrovin and G. V. Balabina (Inst. of Physical Problems). Doklady Akad. Nauk S.S.S.R. **102**, 719-21 (1955) June 1. (In Russian)

5998

EFFECT OF ISOTOPIC SUBSTITUTION ON THE MASS SPECTRA OF MOLECULES. II. OXYGEN AND CARBON DIOXIDE, EXPERIMENTAL. Oliver A. Schaeffer and Henry R. Owen (Brookhaven National Lab., Upton, Long Island, New York). J. Chem. Phys. **23**, 1305-9(1955) July.

The relative changes in the probability of bond breaking

following electron impact have been studied for the molecules $O^{16}O^{16}$ and $O^{16}O^{18}$, $O^{16}C^{12}O^{16}$, $O^{16}C^{13}O^{16}$, and $O^{16}C^{12}O^{18}$. The experimental results were obtained with a 60° mass spectrometer employing a source designed to equalize the collection efficiency of the fragment ions formed. The relative changes were studied systematically as a function of the various ion source voltages. In the case of oxygen the ratio of bond breaking in $O^{16}O^{18}$ divided by that in $O^{16}O^{16}$ is 0.98. The formation of C^+ from $O^{16}C^{13}O^{16}$ is 1.022 times the formation of C^+ from $O^{16}C^{12}O^{16}$ while the formation of C^+ from $O^{16}C^{12}O^{18}$ is 0.997 times the formation of C^+ from $O^{16}C^{12}O^{16}$. The formation of CO^+ from $O^{16}C^{13}O^{16}$ is 0.974 times that from $O^{16}C^{12}O^{16}$ while the relative formation of $C^{12}O^{18+}$ from $O^{16}C^{12}O^{18}$ is 1.03 times and that of $C^{12}O^{16+}$ is 0.97 times the formation of CO^+ from $O^{16}C^{12}O^{16}$. Finally the relative formation of O^{16+} is 1.05 times and that of O^{18+} is 0.98 times the formation of O^+ from $O^{16}C^{12}O^{16}$. (auth)

5999

EFFECT OF ISOTOPIC SUBSTITUTION ON THE MASS SPECTRA OF MOLECULES. III. CARBON DIOXIDE, THEORETICAL INTERPRETATION. Oliver A. Schaeffer (Brookhaven National Lab., Upton, Long Island, New York). *J. Chem. Phys.* **23**, 1309-13(1955) July.

The relative changes in pattern for O^{18} and C^{13} substituted carbon dioxide are calculated. The frequencies for the isotopic carbon dioxide molecules and the associated normal coordinates are obtained for a harmonic potential function. These are then used as the basis for the ground-state vibrational wave functions. The bond breaking probability integrals are evaluated for various values of the "critical" internuclear separation r_c , and a study is made of the change in predicted bond breaking ratios as a function of r_c . The values of r_c are chosen which give the experimental pattern for $O^{16}C^{12}O^{16}$ and then the relative changes in pattern are calculated for the other molecules and are compared with experimental values. Especially striking is the fact that the calculation faithfully reproduces the change in pattern for the case of a heavier molecule, which is more likely to fragment than a lighter one, as well as for the reverse case. It is concluded that a Franck-Condon type calculation adequately describes the electron impact process in carbon dioxide. (auth)

6000

A TWO STAGE MAGNETIC ANALYZER FOR ISOTOPIC RATIO DETERMINATIONS OF 10^4 TO 1 OR GREATER. F. A. White and T. L. Collins (Knolls Atomic Power Lab., Schenectady, N. Y.). *Appl. Spectroscopy* **8**, 163-79(1954) Nov.

Emphasis is placed on the theory, physical arrangement, and magnetic field control of a two stage magnetic analyzer for isotopic ratio determinations. The performance of the instrument was checked by taking the mass spectra of several elements. It is concluded that, insofar as ratio measurements are concerned, this instrument is superior to any single-stage analyzer not employing velocity selection. (B.J.H.)

MEASURING INSTRUMENTS AND TECHNIQUES

6001 NYO-7317

Princeton Univ., N. J. Palmer Physical Lab.
A FOCUSING ATOMIC BEAM APPARATUS: THEORY AND DESIGN. Aaron Lemonick, Francis M. Pipkin, and Donald R. Hamilton. June 15, 1955. 121p. Contract [AT(30-1)-937, Scope II].

A magnetic resonance atomic beam apparatus has been constructed. In the deflecting magnets, a focusing principle has been used to increase the available intensity. This apparatus is of the "flop-in" type and has been used for measurement of the spins and details of hyperfine splittings associated with radioactive nuclei. Detection of transitions is by counting of radioactivity deposited on a collecting button. A discussion of design of the apparatus and the associated atom optics is given. Details of magnet construction and other physical details are also presented. The theory and method of making a measurement are described. The solid angle subtended at the oven in this type of focusing apparatus and in the conventional type apparatus is discussed in some detail, and it is shown that the focusing feature should increase this useful solid angle by a factor of the order of magnitude of fifty. (auth)

6002

ASSAY OF γ -RADIATION FROM THE HUMAN BODY. P. R. J. Burch and D. B. Appleby (Univ. of Leeds, England). *Atoms* **6**, 195-201(1955) July.

A detailed account of the instrumentation and a discussion of some of the problems presented by measurements of γ radiation emitted from the human body are presented. (B.J.H.)

6003

THE FLUORESCENCE OF ZINC SULFIDE. W. Hoogenstraaten. *Ned. Tijdschr. Natuurk.* **21**, 150-9(1955) June. (In Dutch)

A survey is given of the chemical and physical structure of the phosphors of the ZnS type. The discrete electronic levels in the forbidden energy gap between the valence- and the conduction band, which determine the fluorescence characteristics of the phosphor, are described as perturbed crystal levels. It is shown that the bimolecular reaction mechanism of the electronic processes in the phosphor is responsible for the non-linear properties of the fluorescence, the decay and other luminescence phenomena. (auth)

6004

A METHOD OF MEASURING CYCLO THERAPY BY AN ELECTRONIC INTERPOLATING DOSIMETER. A. Bercy. *J. radiol. et electrol.* **36**, No. 5-6, 428-32(1955). (In French)

Complete descriptions, diagrams, and circuits are given for an instrument which will give the integrated dose from cyclotherapy. (B.J.H.)

6005

METHOD OF DOSIMETRY IN ROTATING RADIOTHERAPY. A. Herve. *J. radiol. et electrol.* **36**, No. 5-6, 432-8(1955). (In French)

Dosimetry in rotating radiotherapy is discussed in various aspects. The problems of such measurements are set down, and three methods of measurement are discussed, with emphasis being placed on experiments done in indirect measurement of dose. Diagrams of equipment used are shown. (B.J.H.)

6006

BACKGROUND COUNT IN A SYSTEM OF GEIGER-MÜLLER COUNTERS IN COINCIDENCE. André Papineau (C. E. N. de Saclay). *J. phys. radium* **16**, 468-72(1955) June. (In French)

In seeking to give evidence for a neutrino-electron interaction, the background counting rate of coincidence counters had to be reduced. The self-activity of the counters was reduced by studying the contribution of numerous materials. The effect of the surrounding air and the best protection

capable of decreasing background were studied. With the exception of statistical accuracy, no neutrino-electron interaction has been revealed. (tr-auth)

6007

MEASUREMENTS OF NEUTRON DOSE AS A FUNCTION OF LINEAR ENERGY TRANSFER. Harold H. Rossi and Walter Rosenzweig (Columbia Univ., New York). Radiation Research 2, 417-25(1955) July.

A mathematical formula is presented by which the neutron dose delivered per interval of linear energy transfer may be derived from counting data obtained with a spherical proportional counter having a wall of tissue-equivalent plastic and filled with methane gas at low pressure. Measurements were made on three types of neutron sources, and the spectra analyzed on a twenty-four channel differential pulse-height analyzer. Results are presented graphically and are compared with theoretical calculations. (C.H.)

6008

A SIMPLE TECHNIQUE FOR COUNTING MILLIGRAM SAMPLES OF PROTEIN LABELLED WITH ^{14}C OR ^{35}S . J. Garrow and E. A. Piper (Medical Research Council, West Indies and National Inst. for Medical Research, London). Biochem. J. (London) 60, 527-8(1955) July.

6009

ON THE TEMPERATURE COEFFICIENT OF EXTERNAL CATHODE GEIGER-MÜLLER COUNTERS CONTAINING AN ORGANIC VAPOR. Daniel Blanc and René Viste. Compt. rend. 240, 2405-7(1955) June 20. (In French)

The change between 20 and 240°C of the characteristic for the fillings containing methylal and ethanol is discussed. Below a temperature t_0 , the thermal coefficient due to the adsorption of the polyatomic constituent on the walls is proportional to its partial pressure. It is below the values obtained with internal cathodes. Above t_0 , the variation becomes rapid. (tr-auth)

6010

A π -TYPE OF MASS SPECTROMETER FOR ISOTOPE ABUNDANCE MEASUREMENTS. P. V. Krishnamurthy and R. K. Asundi (Tata Institute of Fundamental Research, Bombay, India). J. Sci. Ind. Research (India) 14, 195-200(1955) May.

The instrument parts and circuiting of an all-metal π -type mass spectrometer for isotope abundance measurements in the range 1-1000 are described. The demountable universal gas type of ion source employed facilitates easy replacement by furnace or filament type for solid samples. An adjustable exit slit enables the variation of the resolving power to suit the mass range under study. The whole instrument is compactly mounted on wheels and operates directly from 220 V. a.c. mains. The performance and range of the instrument have been illustrated by a mass spectrogram for carbon dioxide. Isotope components present to the extent of 1 part in 10,000 can be detected with the d.c. amplifier employed. (auth)

MESONS

6011 AEC-tr-2191

PRODUCTION OF π^0 MESONS BY NEUTRONS. B. M. Pontecorvo and G. I. Selivanov. Translated by Luke C. L. Yuan from Doklady Akad. Nauk S.S.S.R. 102, 253-6(1955). 12p.

An abstract of this paper appears in Nuclear Science Abstracts as NSA 9-5742.

6012

PHOTOPRODUCTION OF NEGATIVE π MESONS ON DEUTERIUM. M. I. Adamovich, G. V. Kuz'micheva, V. G. Laronova (Lebedev Physics Inst.). Doklady Akad. Nauk S.S.S.R. 102, 715-18(1955) June 1. (In Russian)

Nuclear emulsions were saturated with D_2O and exposed to synchrotron γ rays of up to 250 Mev energy. Cross-section and energy-distribution data for the equation $\gamma + d \rightarrow p + p + \pi^-$ are plotted. (G.Y.)

6013

PRODUCTION FREQUENCY OF NEUTRAL π -MESONS IN HIGH ENERGY INTERACTIONS. D. Lal, Yash Pal, and Rama (Tata Inst. of Fundamental Research, Bombay, India). Proc. Indian Acad. Sci. 39A, 127-31(1954).

A determination was made of the ratio of neutral π mesons to charged π mesons in high-energy interactions. Median interaction energy was 100 Bev/nucleon. Results are tabulated with those of other workers. (B.J.H.)

6014

PHOTOPRODUCTION OF POSITIVE PIONS IN HYDROGEN-MAGNETIC SPECTROMETER METHOD. R. L. Walker, J. G. Teasdale, V. Z. Peterson, and J. I. Vette (Calif. Institute of Tech., Pasadena). Phys. Rev. 99, 210-19(1955) July 1.

Positive pions produced in a cold, high-pressure hydrogen gas target by the 500-Mev bremsstrahlung of the CalTech synchrotron, have been analyzed by a large magnetic spectrometer. The photoproduction cross section has been measured as a function of photon energy at laboratory angles of 12.5°, 30°, 51°, 73°, 104°, 140°, and 180°. The energy region covered depends somewhat on the angle, but is typically from 200 to 470 Mev. From these excitation curves the angular distribution of the photopions in the center of momentum system is obtained for various photon energies, and these angular distributions are analyzed in the form $A + B \cos \theta + C \cos^2 \theta$. The angular distribution has a backward maximum at low energies and a forward maximum at high energies, the coefficient B changing sign at about 340 Mev. The total cross section shows a striking maximum near 290 Mev, of magnitude $205 \times 10^{-30} \text{ cm}^2$, and falls off above the maximum faster than λ^2 . (auth)

6015

PHOTOPRODUCTION OF POSITIVE PIONS IN HYDROGEN-COUNTER TELESCOPE METHOD. A. V. Tollestrup, J. C. Keck, and R. M. Worlock (Calif. Institute of Tech., Pasadena). Phys. Rev. 99, 220-8(1955) July 1.

The excitation functions for positive pion production from hydrogen have been obtained in the energy region from 230 Mev to 450 Mev and at laboratory pion angles of 24°, 38°, 53°, 73°, 93°, 115°, 140°, and 160°. The pions are detected and identified by measuring their range and ionization in a scintillation counter telescope. The above data are analyzed to give the angular distribution in the center-of-momentum system, and a least-squares analysis made to determine coefficients in $\sigma(\theta) = A + B \cos \theta + C \cos^2 \theta$. The total cross section shows a peak at 300 Mev of magnitude $2.20 \times 10^{-28} \text{ cm}^2$. The coefficient B passes through a maximum negative value at 250 Mev and then passes through zero at 325 Mev and remains positive up to the highest energy measured. (auth)

6016

HEAVY MESONS PRODUCED BY 2.2- AND 3.0-BEV PROTONS. R. D. Hill, E. O. Salant, and M. Widgoff (Brookhaven National Lab., Upton, New York). Phys. Rev. 99, 229-41(1955) July 1.

Emulsions were traversed by radiations from a target bombarded by either 2.2-Bev or 3.0-Bev protons. Analyses of tracks of twelve heavy mesons that came to rest in the emulsions are presented. The stopped heavy mesons produced secondaries showing that 2 were tau mesons, 1 was a negative K meson, and 9 were positive K mesons. Grain count, scattering and range measurements served to determine K-meson masses; the average of 6 positive K mesons that could be measured well was $(965 \pm 15)m_e$. Evidence is given, from comparison with existing $p\beta$ -blob density curves, that one K^+ secondary is a muon or electron, while another K^+ secondary is a pion. If, in the latter case, it is assumed that the K^+ decays into a charged and a neutral pion, the mass of the K^+ is found to be $(945 \pm 20)m_e$ and the Q of the decay (207 ± 9) Mev, the same, within experimental error, as for θ^0 . (auth)

6017

PHOTOPRODUCTION OF MESONS IN DEUTERIUM. John Chappellear (Indiana Univ., Bloomington). Phys. Rev. **99**, 254-60(1955) July 1.

The corrections from multiple scattering of the photo-produced meson to the usual impulse approximation to the elastic photoproduction cross section for neutral mesons in deuterium have been computed. The result obtained for gamma-ray energies of 285 Mev and 345 Mev is a depression of the cross section of about a factor of two at all angles and at both energies. This is in qualitative accord with experiment. (auth)

6018

ELASTIC PHOTOPRODUCTION OF π^0 MESONS FROM DEUTERIUM. B. Wolfe, A. Silverman, and J. W. DeWire (Cornell Univ., Ithaca, New York). Phys. Rev. **99**, 268-72 (1955) July 1.

The average differential cross section for the reaction $\gamma + d = \pi^0 + d$ has been measured for photons between 250 and 300 Mev at four angles. A difference measurement with deuterio-paraffin and normal paraffin targets was employed. The recoil deuterons were detected by a counter telescope which discriminated against protons by recording the product of the energy and the specific ionization loss of the particles. The reaction was further identified by demanding a coincidence between the deuteron pulse and a pulse from a photon counter placed at an angle corresponding to the direction of the π^0 . The values of the differential cross section for various angles of the π^0 in the laboratory system are as follows:

$d\sigma/d\Omega$		$d\sigma/d\Omega$	
$\theta(\pi^0)$	$(10^{-30} \text{ cm}^2/\text{steradian})$	$\theta(\pi^0)$	$(10^{-30} \text{ cm}^2/\text{steradian})$
76°	4.2 ± 0.6	110°	2.5 ± 0.4
93°	3.2 ± 0.5	130°	1.2 ± 0.3

The stated errors are the standard statistical errors and apply to the relative cross sections at the various angles. The absolute cross-section scale is subject to an experimental error of 25 per-cent. The measured cross sections are in agreement with theoretical calculations based on the impulse approximation, with the assumption of equal amplitudes for π^0 production from the proton and neutron and constructive interference. (auth)

6019

ELASTIC PHOTOPRODUCTION OF π^0 MESONS FROM DEUTERIUM AT 270 MEV. H. L. Davis and D. R. Corson

(Cornell Univ., Ithaca, New York). Phys. Rev. **99**, 273-7 (1955) July 1.

The cross section for the process $\gamma + d \rightarrow \pi^0 + d$ has been measured by observing the recoil deuteron. The recoil was first analyzed by a uniform magnetic field and then allowed to pass through a nuclear emulsion. The following values were obtained for the absolute cross section for π^0 production at a photon energy of 270 Mev and π^0 laboratory angles 124° and 168° : $d\sigma/d\Omega(124^\circ) = 3.2 \pm 0.9 \mu\text{b/steradian}$ and $d\sigma/d\Omega(168^\circ) = 1.3 \pm 0.5 \mu\text{b/steradian}$. The fact that the cross section is the same order of magnitude as the cross section for the production of π^0 's from hydrogen is evidence that constructive interference exists between the π^0 production from the proton and the π^0 production from the neutron. On the basis of approximate theories of meson production from deuterium, a lower limit is deduced for the isotropic part of the angular distribution of π^0 's photoproduced from hydrogen. (auth)

6020

ENERGY DISTRIBUTION OF γ RAYS FROM π^0 DECAY. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. **99**, 277-81(1955) July 1.

It is shown that the γ -ray energy distribution resulting from the decay of π^0 mesons produced in a target bombarded by a high-energy particle beam is related in a simple manner to the differential π^0 production cross section, for sufficiently high energies of γ 's (≥ 500 Mev). An expression is obtained for the π^0 production cross section in terms of the γ -ray energy distribution. This result is extended to the case of an arbitrary two-body decay, for which an expression is obtained for the production cross section of the primaries in terms of the energy distribution of the secondaries emitted in the decay. (auth)

6021

ASSOCIATED PHOTONS IN K-PARTICLE DECAYS OBSERVED WITH A MULTIPLATE CLOUD CHAMBER. H. Courant (Massachusetts Institute of Tech., Cambridge). Phys. Rev. **99**, 282-7(1955) July 1.

The existence of photons among the decay products of K-mesons is confirmed [see Bridge, Courant, DeStaebler, and Rossi, Phys. Rev. **91**, 1024(1953)]. If these photons arise through a two-body decay process, it is not possible to assume that they are produced directly as the neutral product; however, they can be accounted for quite naturally by assuming that the neutral product is a π^0 -meson. The frequency with which the photons are observed is low and for this reason it is not possible to interpret all the decay events observed in the cloud chamber in terms of a single two-body decay process in which the neutral particle is a π^0 -meson. The statistical arguments leading to this conclusion are given. (auth)

6022

DECAY OF SPIN-ZERO MESONS INTO TWO LEPTONS. Hironari Miyazawa and Reinhard Oehme (Univ. of Chicago, Ill.). Phys. Rev. **99**, 315-24(1955) July 1.

The following general theorem is formulated: The matrix element for the decay of spin-zero mesons with mass m into two leptons with masses μ_1 and μ_2 respectively contains only terms proportional to μ_1/m and μ_2/m , if in the open polygonal arc of lepton lines the number of matrices γ_μ plus the number of internal lines (S_F -functions) is odd. There can also be terms proportional to μ_1/m if virtual leptons with $\mu_1 \neq \mu_2$ appear in the arc. Application of

this theorem to the reaction $\pi^0 \rightarrow e^+ + e^-$ leads to a ratio of the one pair to the two pair decay of the order $(\mu_e/m_\pi)^2 \sim 10^{-5}$. A priori one would expect this ratio to be of the order one. Furthermore, the theorem provides a more general basis for the discussion of the relative probability of the reactions $\pi \rightarrow \mu + \nu$ and $\pi \rightarrow e + \nu$. (auth)

6023

BEVATRON K-MESONS. Robert W. Birge, Roy P. Haddock, Leroy T. Kerth, James R. Peterson, Jack Sandweiss, Donald H. Stork, and Marian N. Whitehead (Univ. of California, Berkeley). *Phys. Rev.* **99**, 329-30(1955) July 1.

A description is given of a strong-focusing spectrometer which was used in conjunction with the Berkeley Bevatron to study Bevatron K mesons. Results of the search for K mesons are discussed. (B.J.H.)

6024

MEASUREMENTS ON K-PARTICLES FROM THE BEVATRON. Warren W. Chupp, Gerson Goldhaber, Sulamith Goldhaber, Stephen J. Goldsack, Joseph E. Lannutti, Frances M. Smith, and Francis H. Webb (Univ. of California, Berkeley). *Phys. Rev.* **99**, 335-6(1955) July 1.

Nuclear emulsions were exposed to the direct proton beam of the Bevatron and to the secondaries emitted at 90° to the first target. Measurements on resultant K particles and their secondaries are tabulated. (B.J.H.)

6025

ABSORPTION EXPERIMENTS INVOLVING HEAVY MESONS. T. D. Lee (Columbia Univ., New York). *Phys. Rev.* **99**, 337-8(1955) July 1.

It is pointed out that properties of heavy mesons may be obtained by performing experiments in the absorption of K^- particles by deuterons, He^4 and C^{12} . (B.J.H.)

6026

FURTHER OBSERVATIONS OF NEGATIVE K MESONS.

J. Hornbostel and E. O. Salant (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **99**, 338-9(1955) July 1.

Emulsions which had been exposed to the Bevatron proton beam were searched for K^- meson tracks. The average value of the K^- mass was found to be $(931 \pm 24) m_e$. (B.J.H.)

NEUTRONS

6027 IDO-16115(1st Rev.)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

THE REFLECTIVITY OF NaCl AND Be CRYSTALS FOR SLOW NEUTRONS. M. W. Holm. Mar. 24, 1955. 29p. Contract AT(10-1)-205.

The relative intensities of Bragg reflections of slow neutrons from a number of NaCl and Be crystal planes are calculated for the first three orders and the results presented in both graphic and tabular form. The Debye-Waller temperature correction factor and the crystal structure factor are examined with a view to determining conditions leading to maximum order discrimination consistent with resolution and intensity requirements. (auth)

6028 KAPL-336

Knolls Atomic Power Lab., Schenectady, N. Y. SELF-ABSORPTION OF MONOENERGETIC NEUTRONS. W. J. C. Bartels. May 1, 1950. Decl. Jan. 27, 1955. 23p. Contract W-31-109-eng-52.

A method is outlined that will enable reactor calculations to account for a decrease in the absorption of monoenergetic neutrons by strong absorbers that are localized

rather than spread homogeneously through the reactor core. For equal volumes of absorber in several geometries, the decrease is compared. (auth)

6029 NYO-6267

Nuclear Development Associates, Inc., White Plains, N. Y. PENETRATION OF NEUTRONS FROM A POINT ISOTROPIC FISSION SOURCE IN WATER. R. Aronson, J. Certaine, H. Goldstein, and S. Preiser. Sept. 22, 1954. Decl. Jan. 18, 1955. 24p. Contract AT(30-1)-862. (NDA-15C-42)

The method of moments has been used to compute fast neutron doses and differential number spectra in the energy range 0.33 to 18 Mev out to 120 cm of water for point isotropic fission neutron sources. Four problems, which differ in the mesh width used in the numerical integration and in the treatment of the term describing scattering by oxygen, have been done. It is concluded that for hydrides of elements heavier than oxygen the heavy component can be taken as having infinite mass. The attenuation length in the 60 to 120 cm range is 10 cm. A short discussion of the general shape of the spectra and of the effect of the details of the oxygen cross section is included. (auth)

6030 NYO-6269

Nuclear Development Associates, Inc., White Plains, N. Y. PENETRATION OF NEUTRONS FROM POINT ISOTROPIC MONOENERGETIC SOURCES IN WATER. R. Aronson, J. Certaine, and H. Goldstein. Dec. 15, 1954. Decl. Jan. 18, 1955. 52p. Contract AT(30-1)-862. (NDA-15C-60)

Doses and differential number spectra at distances of up to 120 cm. are presented for neutrons in water from several point isotropic sources. For most of the problems the sources emitted nearly monoenergetic neutrons, in narrow energy bands centered respectively at 2, 4, 6, 8, 10 and 14 Mev. Energy degradation on scattering by oxygen was ignored in all but two 14-Mev source problems. One of these used the nearly monoenergetic type of source, and the results showed the effect of degradation to be small. The other had a monoenergetic δ -function source. However, the numerical procedure proved inadequate to handle the problem because of the strongly forward scattering by oxygen at 14 Mev. For the low-energy portion of the spectra (from 300 kev down to 50 kev for some problems) it was found that spatial equilibrium is established quite close to the source. The same was observed for a fission source at energies as low as 2 ev. It is shown that in the 2 ev-300 kev region the energy dependence can be given by a simple formula in terms of the hydrogen cross section. At distances of 30 cm. and more from the source the spatial dependence of the spectrum closely parallels that of the fast neutron dose curve. The various monoenergetic sources were combined so as to simulate a fission source. The resultant spectra and dose curves agree extremely well with the values calculated previously for an actual fission source. Similar combination techniques can be used to determine neutron penetration from other continuous sources. (auth)

6031

SCATTERING OF POLARIZED NEUTRONS BY HEAVY NUCLEI. Albert Okazaki (Univ. of Wisconsin, Madison). *Phys. Rev.* **99**, 55-8(1955) July 1.

The polarization of $\text{Li}(p,n)$ neutrons emitted at a laboratory angle of 50° was measured as a function of proton energy from 2.21 to 2.40 Mev. Analysis of the polarization of the neutrons was performed by measuring the left-right

asymmetry in scattering by oxygen. To determine more accurately the polarization produced in scattering by oxygen, the total cross section and angular distribution of scattered neutrons were remeasured. Measurements of the polarization of neutrons produced in the scattering by intermediate and heavy nuclei have been continued. The results were compared with polarizations calculated by assuming the complex square-well model proposed by Feshbach, Porter, and Weisskopf and modified by the addition of a spin-orbit interaction. (auth)

6032

ALTERNATIVE INTERPRETATIONS OF SLOW-NEUTRON CROSS SECTIONS. O. Kofoed-Hansen (Columbia Univ., New York). *Phys. Rev.* **99**, 154-8(1955) July 1.

The many-level formula of the theory of neutron resonance cross sections developed by Feshbach, Peaslee, and Weisskopf has been applied to the lowest resonances in Ag and Au. It is concluded that the approximations involved in the derivation of the usual Breit-Wigner one-level formula may lead to larger deviations in the determination of the constants in this formula than indicated by the usually applied statistical errors. In particular, a fit is obtained with a nuclear radius given as $1.47A^{1/3} \times 10^{-13}$ cm. (auth)

6033

SYSTEMATICS OF NEUTRON CAPTURE CROSS SECTIONS. B. G. Harvey (Univ. of California, Berkeley). *Phys. Rev.* **99**, 333-4(1955) July 1.

A rough correlation between neutron capture cross sections of trans-lead nuclides and the binding energy of the captured neutron is demonstrated and discussed. (B.J.H.)

6034

ESCAPE FRACTION OF PROTONS PRODUCED BY NEUTRONS INCIDENT ON PHOTOGRAPHIC PLATES: J. Catala, F. Senet, J. Aguilar, and R. Font. (Instituto de Optica, Valencia, Spain). *Anales real soc. españ. fís. y quim. (Madrid)* **51A**, 127-40(1955) May-June. (In Spanish)

A theoretical method is presented for calculating the escape fraction of protons produced by a neutron beam, entering a photographic plate at an angle. The examples given are angles of 0, 10, and 15, the thickness of the emulsion being 100 μ , and only tracks of recoiling forward protons at angles of less than 20° from the direction of the neutrons were accepted. (auth)

NUCLEAR PHYSICS

6035 UCRL-3014

California. Univ., Berkeley. Radiation Lab. PHYSICS DIVISION QUARTERLY REPORT [FOR] FEBRUARY, MARCH, APRIL 1955. May 25, 1955. 55p. Contract W-7405-eng-48.

About 160 stars from 5.7-Bev protons in emulsion have been analyzed according to prong-number distribution, and the results are tabulated. Results are given on low-energy neutron spectra from 200-Mev proton bombardment of nuclei. The frequency distribution of number of prongs per star caused by 380-Mev α particles in emulsion is given. A table is given of mass measurements of 22 K particles in emulsions exposed to the Bevatron beam. A table is given on properties of τ mesons. Pion-proton cross sections are given for 3.2- and 4.4-Bev pion beams. A detailed study of the resolution of a spiral-orbit spectrometer is given. The μ -meson positron spectrum was measured with a 180° magnetic-focusing spectrometer and with the spiral-orbit spectrometer. What is thought to be a

θ^+ meson was identified. The prong distribution of 15 K stars is given. (B.J.H.)

6036

LXIII. ON THE OPTICAL MODEL FOR NUCLEON SCATTERING BY OXYGEN. Y. Fujimoto and A. Hossain (Univ. of Bristol, England). *Phil. Mag.*, (7), **46**, 542-5(1955) May.

Calculations were made to find the nuclear radius and parameters of the complex potential which would best fit experimental data. Specifically, parameters were chosen to explain the angular distributions of 9.5- and 14.1-Mev protons scattered by O. (B.J.H.)

6037

SUPERALLOWED BETA TRANSITIONS IN THE N - Z = 3 SERIES. Eugene Feenberg (Washington Univ., St. Louis, Missouri). *Phys. Rev.* **99**, 71-5(1955) July 1.

A number of fast beta transitions have been found in the N - Z = 3 series of radioactive nuclides. King has suggested that some of these transitions (for A < 27) occur within the lowest [4...421] or [4...432] supermultiplet; hence are superallowed (or favored). Matrix elements of $|\int \sigma|^2$ within the [21] and [32] supermultiplets are computed with the aid of two-way displacement operators on the eigenvalues of T_3 , S_z , and Y_{32} . In the application to ${}^8\text{O}_{11}$ the only spin assignments consistent with an LS coupling interpretation of the fast transition are $I_1 = 5/2$, $I^* = 3/2$ ($S^* = 1/2$). These are the values favored by the available experimental information. The jj coupling value of $|\int \sigma|^2$ for the ${}^8\text{O}_{11}$ transition is too large by a factor of five. (auth)

6038

PRODUCTION OF HEAVY UNSTABLE PARTICLES IN A p-p COLLISION. M. M. Block (Naval Research Lab., Washington, D. C.) and E. M. Harth (Duke Univ., Durham, North Carolina). *Phys. Rev.* **99**, 261-3(1955) July 1.

A hydrogen-filled diffusion cloud chamber was exposed to a 2.7-Bev proton beam. In a collection of 202 p-p collisions, there was one event interpreted as the associated production of a hyperon and a K-meson, via the reaction $p + p \rightarrow A^+ + K^+ + n$. (auth)

NUCLEAR PROPERTIES

6039 IDO-16225

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

THERMAL NEUTRON ACTIVATION CROSS SECTION OF Np^{237} . R. R. Smith, T. O. Passell, N. P. Alley, and R. H. Lewis. May 10, 1955. 14p. Contract AT(10-1)-205.

Neutron activation studies of Np^{237} in the graphite region of the Materials Testing Reactor (MTR) have resulted in a value of 169 ± 8 barns for the thermal neutron activation cross section. Techniques of thin sample preparation, and 4π alpha and beta counting are discussed. (auth)

6040

ON THE DISTRIBUTION OF ELECTRIC CHARGE OF THE NUCLEUS. Jean Reignier. *Bull. classe sci. Acad. roy. Belg.* **41**, No. 2, 151-64(1955). (In French)

A method of calculation by successive approximations starting from an electric distribution on the surface is presented. Within almost all the region where the procedure converges, the first approximation gives practically the exact result. Two distributions are equivalent for the considered tests if they give the same value to a certain expression. (tr-auth)

6041

ANGULAR DISTRIBUTION OF FAST NEUTRONS SCAT-

TERED BY MAGNESIUM. Pablo Okhuysen, Jr. and Walter E. Millett (Univ. of Texas, Austin). *Rev. mex. fis.* **4**, 1-12 (1955) Jan. (In Spanish)

This is a report on a measurement of the differential cross section (elastic plus inelastic) of natural magnesium for fast neutrons (estimated to have a mean energy of 2.77 ± 0.05 Mev) using the ring scatterer method. The neutrons were obtained from the $D(d,n)He^3$ reaction using the 100,000-volt modified Cockcroft-Walton accelerator at the Nuclear Physics Laboratory of the University of Texas. (auth)

6042

SCATTERING OF FAST NEUTRONS BY LEAD AND SILVER. Thomas Bonner, Fernando Alba, Alonso Fernandez, and Marcos Mazari. *Rev. mex. fis.* **4**, 52-9(1955) Jan. (In Spanish)

The total cross section for neutron scattering in lead and silver has been measured using monoenergetic neutrons with energies which were varied from 12.9 to 16.2 Mev. The total cross section in silver becomes smaller as the energy is increased, while the cross section in lead is greater at the higher neutron energies. In the case of lead there appears to be a broad maximum in the cross section curve at a neutron energy of 16 Mev. (auth)

6043

SCATTERING OF Co^{60} γ RAYS BY THE ELECTRIC FIELD OF NUCLEI. Philippe Eberhard and Lazare Goldzahl. *Compt. rend.* **240**, 2304-6(1955) June 13. (In French)

The effective cross sections for coherent scattering of Co^{60} γ rays in lead, uranium, and tin are given. The precision of the results is justified, which gives evidence of scattering by the electric field of the nuclei. (tr-auth)

6044

COMPARISON OF THERMAL NEUTRON FISSION CROSS SECTIONS FOR U^{235} AND Pu^{239} . Jean-Michel Auclair, Claude Breton, Pierre Hubert, Rene Joly, and Jean Tachon. *Compt. rend.* **140**, 2306-8(1955) June 13. (In French)

Some deposits of U^{235} and Pu^{239} have been compared in a fission chamber and by α counting. It is deduced from this that the ratio between the effective fission cross sections of U^{235} and Pu^{239} within a Maxwellian distribution at ordinary temperatures is equal to $0.626 \pm 1\%$. (tr. auth)

6045

SPACINGS AND NEUTRON WIDTHS OF NUCLEAR ENERGY LEVELS. J. A. Harvey, D. J. Hughes, R. S. Carter, and V. E. Pilcher (Brookhaven National Lab., Upton, New York). *Phys. Rev.* **99**, 10-32(1955) July 1.

The parameters of nuclear energy levels at excitation energy just above neutron binding have been studied for about 20 heavy nuclides. Total cross sections for neutrons of energy 0 to 700 ev were made, utilizing the Brookhaven fast chopper and the transmissions were analyzed to obtain the resonance parameters. The reduced neutron widths, Γ_n^0 , show a wide variation among the resonances in single nuclides relative to radiation widths, Γ_γ . Within experimental error, the size distribution of the reduced neutron widths is exponential, the most probable width being zero. The experimental level spacings, D , exhibit discontinuities at closed shells, an effect that remains after correction of the spacings for differences in excitation energy. The ratio Γ_n^0/D , of particular significance to the "cloudy crystal ball" nuclear model, has a maximum about $A = 160$, as expected from theory, but of a much smaller magnitude than the computed peak. (auth)

6046

Z-DEPENDENCE OF BREMSSTRAHLUNG. W. C. Barber, A. I. Berman, K. L. Brown, and W. D. George (Stanford Univ., California). *Phys. Rev.* **99**, 59-61(1955) July 1.

The relative amounts of bremsstrahlung produced by the elements Cu, Ta, Pb, and U for incident electrons of energy 24 and 34 Mev were measured by using the $Cu^{63}(\gamma,n)Cu^{62}$ reaction as the photon detector. Because of the shape of the cross-section function, photons were detected in a comparatively narrow energy band centered at 17.5 Mev. The electron beam was monitored by a Faraday cup placed immediately behind the radiator and detector foils. Corrections were applied to account for ionization and radiation losses of the electrons, and for pair production and Compton losses of the photons. The experimentally-determined "thin-target" cross sections relative to copper for Ta, Pb, and U, respectively, were 5.681 ± 0.13 , 6.959 ± 0.16 , and 8.221 ± 0.19 per atom, at 24 Mev; and 5.583 ± 0.08 , 6.770 ± 0.09 , and 8.172 ± 0.12 at 34 Mev. These values are from five to thirteen % lower than the corresponding ratios calculated from the Bethe-Heitler theory (including screening and radiation produced in collision with atomic electrons). The results are consistent with a deviation from theory of $(1.54 \pm 0.2) \times 10^{-3} Z^2 \%$ for 24-Mev electrons, and $(1.38 \pm 0.14) \times 10^{-3} Z^2 \%$ for 34-Mev electrons. (auth)

6047

EXCITED STATES OF Ce^{140} . Herbert H. Bolotin, Charles H. Pruett, Paul L. Roggenkamp, and Roger G. Wilkinson (Indiana Univ., Bloomington). *Phys. Rev.* **99**, 62-7(1955) July 1.

Scintillation and magnetic beta-ray spectrometry have been applied to the study of the more important levels of Ce^{140} . Coincidence experiments verify that successive levels are at 1.60, 2.09, 2.42, and 2.53 Mev above the ground state and correspond to gamma rays of energies 1.60, 0.815, 0.490, 0.438, and 0.328 Mev. The relative intensities of the gamma rays are found to be 2.50, 1.15, 1.25, 0.15, and 1.00, respectively. The energies and relative intensities of two weak high-energy transitions have been determined by means of a scintillation pair spectrometer. Values of 2.50 ± 0.05 and 3.00 ± 0.20 Mev are obtained with corresponding intensities of 1% and 0.04% of the 1.60-Mev gamma ray. The beta-ray measurements substantiate the relative intensities and end-point energies of the beta-ray groups which have been reported by others. In addition, it has been possible to estimate the internal conversion coefficients and K/L ratios. The angular correlation of four cascade pairs of the above gamma rays has been studied. The results obtained, together with the beta-ray and internal conversion data, are most consistent with the assignment 0, 2+, 4+, 3+ for the ground state and first three excited states. The assignment 0, 2+, 4+, 4+ cannot be definitely excluded. (auth)

6048

SUPERMULTIPLETS AND SPIN DEPENDENT FORCES. R. W. King (National Research Council, Washington, D. C.). *Phys. Rev.* **99**, 67-70(1955) July 1.

A tentative explanation for a group of favored negatron transitions from nuclei with $N - Z = 3$ is proposed on the basis of a deviation from the supermultiplet formalism due to spin-dependent forces. The experimental evidence is exhibited and discussed. (auth)

6049

NUCLEAR ENERGY LEVEL FINE STRUCTURE AND CON-

FIGURATION MIXING. K. A. Brueckner, R. J. Eden, and N. C. Francis (Indiana Univ., Bloomington). *Phys. Rev.* **99**, 76-87(1955) July 1.

The departure of shell-model states from independent-particle states is investigated by means of transformation methods developed in previous papers. The starting point in this paper is the many-body Schrödinger equation for the nucleus in which the potential energy is assumed to arise from strong short-range two-body interactions. As a consequence the shell-model wave function cannot be a solution of this equation, however it can be related to the actual nuclear wave function by a suitably chosen transformation operator. This operator preserves the energy and angular momentum of low-lying nuclear states; hence it is possible to examine the splitting of energy levels in the shell model space. For a closed shell plus two or three particles this is shown to originate primarily from perturbations due to two-body interactions between the particles outside the shell. The methods used also give information about the nuclear wave function and provide some justification for the use of configuration mixing in determining nuclear magnetic moments. It is noted that the successes of configuration mixing based on two-body forces provide evidence that two-body correlations dominate over many-body correlations for many properties of the nucleus. (auth)

6050

SCARCITY OF LOW-ENERGY LEVELS OF Be^8 APPEARING IN TWO BORON REACTIONS. R. E. Holland, D. R. Inglis, R. E. Malm, and F. P. Mooring (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **99**, 92-5(1955) July 1.

A careful search is made for evidence of possible states in Be^8 in the reactions $\text{B}^{11}(\text{p},\alpha)\text{Be}^8$ and $\text{B}^{10}(\text{d},\alpha)\text{Be}^8$, by magnetic momentum analysis at a variety of angles and bombarding energies. In spite of observing the region corresponding to 3 to 8 Mev several times independently under different conditions, with several thousand counts per point on points spaced only about 100 kev apart, no indication was found of any of the states in this region reported by others on the basis of poorer statistics, mostly in other reactions. Each alpha-particle spectrum observed consists of a sharp ground-state peak and a broad peak of the alpha particles giving rise to the well-known 3-Mev excited state of Be^8 superposed on a continuous background from the break-up of this state and from three-particle break-up. Peaks observed near the equivalent of 10 and 11 Mev in Be^8 are identified as arising from a target impurity. (auth)

6051

ENERGY LEVELS IN Be^9 . L. L. Lee, Jr. and D. R. Inglis (Argonne National Lab., Lemont, Illinois). *Phys. Rev.* **99**, 96-8(1955) July 1.

Magnetic analysis of the reaction $\text{B}^{11}(\text{p},\alpha)\text{Be}^9$ at three angles verifies the existence of rather broad excited states of Be^9 at 1.75 and 3.02 Mev, the peaks of which almost vanish at 90° where the original investigation showed only the well-known 2.43-Mev state. (auth)

6052

GAMMA-RAY YIELDS FROM COULOMB EXCITATION. P. H. Stelson and F. K. McGowan (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **99**, 112-26(1955) July 1.

The yields of γ rays resulting from Coulomb excitation have been measured for the elements Ta, Au, Pt, Tl, Pb, Th, W, Hf, Ag, Pd, Rh, and Mo. The yields of the 137-, 166-, and 303-kev γ rays in Ta and the (277 + 273)- and 550-kev γ rays in Au were studied as a function of proton

energy. No significant deviation from the predictions of the semiclassical theory of Alder and Winther was observed. Reduced transition probabilities for E2 and M1 transitions have been obtained from the γ -ray yields. In four cases these values may be compared to values obtained from direct half life measurements. The good agreement indicates that the absolute cross section for Coulomb excitation is correctly given by the theory. Nuclear distortions based on the observed E2 transition probabilities are compared to those obtained from the observed excitation energies. (auth)

6053

ANGULAR DISTRIBUTION OF GAMMA RAYS FROM COULOMB EXCITATION. F. K. McGowan and P. H. Stelson (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **99**, 127-34 (1955) July 1.

The angular distributions of gamma rays with respect to the incident proton beam on a thick target have been measured for gamma rays following Coulomb excitation in $\text{Pt}^{194,196}$, Au^{197} , Ta^{181} , $\text{Ag}^{107,109}$, Pd^{106} , Pd^{108} , Pd^{110} , and Rh^{103} . The observed angular distributions deviate considerably from the semiclassical theory of angular distributions of gamma rays following Coulomb excitation given by Alder and Winther. Empirical curves of energy-dependent coefficients $a_\nu(\xi)$ for a thick target are obtained from the results for $\text{Pt}^{194,196}$ and Pd^{108} . With these empirical coefficients, information on the spin sequences and the character of the gamma transitions are deduced from the angular distribution measurements in the odd mass nuclei. The spin sequences are as follows: $7/2(\text{E}2)3/2$ and $5/2(\text{E}2 + \text{M}1)3/2$ with $\delta_\gamma = -0.75$ (where $\delta_\gamma = \text{E}2/\text{M}1$) for the 550- and 277-kev transitions, respectively, in Au^{197} ; $11/2(\text{E}2)7/2$ and $11/2(\text{E}2 = \text{M}1)9/2$ with $\delta_\gamma = 0.51$ for the 303- and 166-kev transitions, respectively, in Ta^{181} ; $5/2(\text{E}2)1/2$ and $3/2(\text{E}2 + \text{M}1)1/2$ with $\delta_\gamma = -0.19$ or -1.14 for the 427- and 325-kev transitions, respectively, in $\text{Ag}^{107,109}$; and $5/2(\text{E}2)1/2$ and $3/2(\text{E}2 + \text{M}1)1/2$ with $\delta_\gamma = -0.18$ or -1.17 for the 365- and 305-kev transitions, respectively, in Rh^{103} . (auth)

6054

PHOTODEUTERON/PHOTOPROTON YIELD FROM SULFUR. Laurence S. Ring, Jr. (Iowa State Coll., Ames). *Phys. Rev.* **99**, 137-8(1955) July 1.

An investigation of the relative deuteron/proton yield from sulfur, produced by irradiation with the Iowa State College 65-Mev synchrotron, was made by employing a 12-inch, helium-filled, magnetic cloud chamber as the means of detection. The average curvature and the range of each acceptable track were measured and were used to find an experimental mass histogram that provided a clear indication of proton and deuteron groups. Analysis of the mass histogram produced a ratio of deuterons to protons of 0.19 ± 0.04 . It is estimated that the corresponding ratio for an infinitesimally thick target is 0.15 ± 0.04 . (auth)

6055

DOUBLE SCATTERING EXPERIMENT WITH 96-MEV PROTONS. Karl Strauch (Harvard Univ., Cambridge, Mass). *Phys. Rev.* **99**, 150-4(1955) July 1.

By using 96-Mev protons, a double scattering experiment has been performed with a variety of targets and scattering angles. The observed values of the asymmetry e in the intensity of the second-scattered beam are small. For instance with carbon as a first and second scatterer, and scattering angles of 20° the observed value of $e = +3.6 \pm 1.6$

percent. It is concluded that the polarization P decreases rapidly with decreasing energy below 130 Mev. (auth)

6056

ISOBARIC TRIPLET $\text{Cr}^{48}-\text{V}^{48}-\text{Ti}^{48}$. Raymond K. Sheline and Joseph R. Wilkinson (Florida State Univ., Tallahassee). *Phys. Rev.* 99, 165-8(1955) July 1.

Cr^{48} has been produced by the nuclear reaction $\text{Ti}^{48}(\alpha, 2n)\text{Cr}^{48}$. The gamma spectra of this nuclide have been investigated and peaks found at 118 kev and 307 kev. The two gamma rays are in coincidence and have the same intensity. The gamma rays of the daughter nuclide V^{48} have been shown to appear in the gamma spectra as Cr^{48} decays. The half-life of Cr^{48} has been determined as 24 ± 1 hours. The energy of the Cr^{48} orbital electron capture has been shown to be approximately 1.30 Mev with a very low log f value. A decay scheme for the isobaric triplet $\text{Cr}^{48}-\text{V}^{48}-\text{Ti}^{48}$ is proposed. Using the proposed decay schemes as a basis, the masses of Cr^{48} and V^{48} have been calculated to be 47.96934 ± 22 and 47.96749 ± 7 , respectively. (auth)

6057

ENERGY LEVELS OF Pb^{208} . G. E. Tauber (Western Reserve Univ., Cleveland, Ohio). *Phys. Rev.* 99, 176-9(1955) July 1.

The various hole-particle configurations in the neighborhood of the doubly magic nucleus $Z = 82$, $N = 126$ have been investigated and applied to the excited states of Pb^{208} . For a particle-particle interaction of the form $V = (mP + nQ)V(|r_1 - r_2|)$, where P denotes Majorana and Q Bartlett forces, the energy levels have been calculated in the L - S and j - j limit both for a delta-type and Gaussian potential with various ranges and compared with the experimental results. (auth)

6058

NUCLEAR SPIN AND MAGNETIC MOMENT OF 3.1-HR Cs^{134m} . L. S. Goodman and S. Wexler (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* 99, 192-8(1955) July 1.

The nuclear spin, hyperfine structure constant and magnetic moment of the excited isomer 3.1-hr Cs^{134m} were determined by means of the atomic beam magnetic resonance method. The intensity of the active species was measured by deposition of the beam on a cold surface and subsequent counting. A spin of $8(\hbar)$, a hfs $\Delta\nu = 3684.3 \pm 0.5$ Mc/sec, and a nuclear moment of 1.10 ± 0.01 nm were found. The nuclear magnetic moment proved to be positive in sign. (auth)

6059

RESONANCES IN THE ELASTIC SCATTERING OF PROTONS. B. B. Kinsey (Univ. of California, Berkeley). *Phys. Rev.* 99, 332-3(1955) July 1.

Sharp resonances in the elastic scattering of protons are observed at 22.5 Mev in carbon and at 18.6 Mev in oxygen. Similar resonances could not be detected in other elements. It is noted that this may demonstrate an increased probability of elastic re-emission of the proton in these nuclei. (B.J.H.)

6060

RATIO OF MAGNETIC MOMENTS OF Co^{58} AND Co^{60} . J. C. Wheatley, D. F. Griffing, and R. D. Hill (Univ. of Illinois, Urbana). *Phys. Rev.* 99, 334-5(1955) July 1.

The method of aligning cobalt nuclei in Tutton salts at low temperatures was used to determine the ratio of magnetic moments of Co^{58} and Co^{60} in their ground states. Results are tabulated. (B.J.H.)

6061

NUCLIDE 99^{254} . B. G. Harvey, S. G. Thompson, G. R. Choppin, and A. Ghiorso (Univ. of California, Berkeley). *Phys. Rev.* 99, 337(1955) July 1.

A discussion is given of the long-lived isomer of 99^{254} and of electron capture in 99^{254m} . (B.J.H.)

NUCLEAR REACTORS

6062 AD-35249

North Carolina State Coll., Raleigh.

APPLICATION OF NEUTRON GROUP THEORY TO A REACTOR (thesis). Melvin Reed Keller. 1954. 40p.

The first phase of the study consisted of determining the group constants used in diffusion calculations for 2 groups of neutrons by using the mathematical and experimental values that most nearly describe the physical properties of a nuclear reactor. The constants were applied to the calculation of the critical mass for reflected spherical reactors using the 2-group theory. Emphasis was placed on a basic spherical reactor composed of homogeneously mixed pure U^{235} fuel with water as moderator and surrounded by an infinite graphite reflector. Estimates were made of the effect of stainless steel and cooling water poisons and of voids upon the reactor mass. The critical determinant for 4 groups of neutrons was derived and analyzed. (ASTIA abst.)

6063 CVAC-229T

Consolidated Vultee Aircraft Corp., Fort Worth, Tex. LABORATORY DEVELOPMENT OF REACTOR SIMULATOR. A. E. Soniat. Feb. 22, 1954. 44p. (FZA-9-250)

An electromechanical reactor simulator has been designed and constructed by the Aerophysics Laboratory. The unit satisfactorily simulates the characteristics of an uranium reactor and has been successfully used to check the control system of one such reactor. The simulator solves an approximation of the operational equation representing the relationship between excessive reactivity and neutron flux level through the use of r - c input and feedback networks around a high-gain d - c amplifier. The proportion of n fed back is controlled by four potentiometers, one of them driven by a position servo. These four parameters represent the positions of the dynamic rod and the shim safety rod, the poison level of the reactor, and the effectiveness of the dynamic rod. The outputs of the circuit are visually observed with the panel meter or fed directly into a reactor control system and reactor period, also indicated on a panel meter. Operational instructions are given in the last section of this report including start up procedure, balancing procedure and operating precautions. (auth)

6064 DP-115

Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Augusta, Ga.

A SIMPLIFIED SAFETY ROD ACTUATOR. D. Baker, Jr., W. E. Llewellyn, and J. P. Maloney. May 1955. 20p. Contract AT(07-2)-1.

A winch assembly that operates a safety rod for a nuclear reactor was developed to decelerate the rod after it drops under emergency conditions into the reactor. The assembly is designed to convert the kinetic energy of the falling rod as it nears its limit of travel to rotational energy in the winch. The conversion is accomplished without the aid of

an external power source or an auxiliary snubbing mechanism. (auth)

6065 ORNL-976

Oak Ridge National Lab., Tenn.

A TRANSIENT HEAT TRANSFER ANALYSIS OF THE

MTR MOCK-UP. H. F. Poppendiek and H. C. Claiborne.

Apr. 30, 1951. Decl. May 9, 1955. 28p. Contract W-7405-eng-26.

A prediction of the transient thermal behavior of the Materials Testing Reactor Mockup has been made for the hypothetical condition that all cooling water has been removed suddenly from the system. The fuel assembly and surrounding reactor components are described. An ideal heat flow tube which represents the actual one was postulated, and contract resistances along the tube were computed for air at 200°F. Analyses were made for 2 power levels of operation before shutdown, and results are presented. The solutions for both cases indicate that at the time the melting temperature of the Al fuel assembly is reached, only a small amount of heat has started to flow into the later part of the thermal circuit. (M.P.G.)

6066 TID-5262

Oak Ridge School of Reactor Technology, Tenn.

REACTOR PHYSICS LABORATORY MANUAL. July 1955. 95p.

The experiments in the ORSORT course are given in detail. They are divided into four groups: atomic physics, neutron physics, nuclear reactor physics, and chemistry. (B.J.H.)

6067

MATERIALS FOR NUCLEAR POWER REACTORS. Henry H. Hausner and Stanley B. Roboff. New York, Reinhold Publishing Corp., 1955. 224p.

A basic but comprehensive picture of the nuclear power reactor is presented in this book. Emphasis is given to the basic concepts involved, the types of and problems with power reactors, and the individual components of the reactor. Included are a list of thermal neutron cross sections and a glossary of nucleonic terms. (B.J.H.)

6068

THE SWEDISH HEAVY WATER REACTOR. Eric Hellstrand (AB Atomenergi, Stockholm, Sweden). *Atomics* 6, 187-94 (1955) July.

Two kinetic experiments with the Swedish heavy water reactor are described. The first one is a study of the phase and amplitude modulation of the neutron flux caused by a rotating cadmium shutter, the second one a study of the time behavior of the pile after a step change in the reactivity. From both measurements the effective life time, l , for thermal neutrons in the multiplying medium has been deduced by comparing the experimental results with the kinetic equations for a bare pile. The values agree within the limits of error and the weighted mean found is $l = 0.71 \pm 0.03$ msec. (auth)

NUCLEAR TRANSFORMATION

6069 UCRL-3012

California. Univ., Berkeley. Radiation Lab.

THE MECHANISM OF THE REACTION $O^{16} + p \rightarrow p + 4\alpha$

AT 29 MEV (thesis). Oscar C. Kolar. May 25, 1955.

63p. Contract W-7405-eng-48.

An expansion cloud chamber containing oxygen gas at $\frac{1}{3}$ atmosphere of pressure was used to study the reaction $O^{16} + p \rightarrow p + 4\alpha$ at 29 Mev. Two hundred and twelve events

were obtained that satisfied the criteria of energy and momentum balance. Ninety-one of these had all five prongs visible, while the remaining 121 had but four prongs visible, the fifth being obscured by the beam. Slightly more than half of all the events showed the presence of the ground state of Be^8 . Of these, five events showed the presence of two Be^8 nuclei in the ground state. The events exhibiting the presence of a single ground state Be^8 were interpreted by the mechanism $O^{16} + p \rightarrow p + 2\alpha + Be^8$, $Be^8 \rightarrow 2\alpha$. The possibility of an intermediate state was investigated. If such an intermediate state did participate, it was such that it did not obey the predications of the compound-nucleus theory. The remaining one-half of the events were not found to show evidence for any intermediate nuclei and could be interpreted only on the assumption of the direct quadripartition of the oxygen nucleus. (auth)

6070

PHOTOPROTONS FROM OXYGEN. B. M. Spicer (Univ. of Illinois, Champaign). *Phys. Rev.* 99, 33-6(1955) July 1.

The cross section and angular distribution of the $O^{16}(\gamma, p)N^{15}$ reaction have been obtained for photon energies between 13.5 and 18.7 Mev, i.e., below the expected position of the giant resonance. The angular distribution indicated that the reaction proceeded predominantly through electric quadrupole or magnetic dipole absorption of photons, even though electric dipole transitions are allowed by isotopic spin selection rules. Suggestions are made regarding this forbiddenness of electric dipole absorption. (auth)

6071

RADIATIVE CAPTURE OF PROTONS BY N^{14} . S. Bashkin, R. R. Carlson, and E. B. Nelson (State University of Iowa, Iowa City). *Phys. Rev.* 99, 107-11(1955) July 1.

The 277-kev resonance for the production of O^{15} in its 7.61-Mev state was excited by proton bombardment of a thick TiN target. A three-crystal scintillation spectrometer resolved gamma rays of 5.25 ± 0.1 Mev, 6.10 ± 0.1 Mev, with relative intensities of 25 ± 6 , 100, and 40 ± 10 , respectively. Direct ground state transitions have a relative intensity of less than 5. The total radiative capture yield in nitrogen is $(2.7 \pm 0.6) \times 10^{-11}$ reaction per proton. The intensity ratio of 6.10-Mev radiation to 5.25-Mev radiation, measured with a single-crystal spectrometer, is 7 ± 3 percent lower at 90° to the beam than at 0° . The asymmetry eliminates pure s-wave capture. It is concluded that the capture state has spin 5/2 and decays by dipole emission to the first three excited states of O^{15} . (auth)

6072

ANGULAR DEPENDENCE OF THE NEUTRON INDUCED FISSION PROCESS. II. J. E. Brolley, Jr., W. C. Dickinson and R. L. Henkel (Los Alamos Scientific Lab., New Mexico). *Phys. Rev.* 99, 159-65(1955) July 1.

The angular anisotropy of neutron-induced fission has been studied with a double fission chamber. For U^{235} at 7.4 Mev and Np^{237} at 14.3 Mev, the variation of the differential fission cross section was found to depend strongly on the fourth power of the cosine of the angle between the fission fragment and the neutron beam. For U^{235} a resonance-type dependence of the anisotropy on neutron energy has been observed. Qualitative indication that the light and heavy fission fragment groups have slightly different anisotropies has been obtained in the case of Np^{237} at 14.3 Mev. (auth)

6073

AVERAGE NUMBER OF NEUTRONS PER SPONTANEOUS FISSION OF Cm^{244} . G. H. Higgins, W. W. T. Crane, and

S. R. Gunn (Radiation Lab., Livermore, Calif.). Phys. Rev. **99**, 183(1955) July 1.

The average number of neutrons per fission, ν , for Cm^{244} has been measured by the manganous sulphate moderator-absorber system. The value 2.60 ± 0.11 has been determined. (auth)

6074

DISINTEGRATION OF ALUMINUM BY PROTONS IN THE ENERGY RANGE 0.4 TO 3.0 BEV. G. Griedlander, J. Hudis, and R. L. Wolfgang (Brookhaven National Lab., Upton, New York). Phys. Rev. **99**, 263-8(1955) July 1.

Excitation functions for the production of Na^{24} , Na^{22} , F^{18} , $\text{O}^{15}(\gamma)$, N^{13} , C^{11} , and Be^7 in proton bombardments of Al have been measured from 0.4 to 3.0 Bev. The formation cross sections have strikingly small energy dependence, and this feature is discussed in the light of possible energy transfer mechanisms. The absolute cross-section values are based on a calibration method (suggested by A. Turkevich) which is discussed. It is based on measurements of gross radioactivity in copper irradiated at various energies and on the assumption that the fraction of inelastic collisions with copper nuclei that lead to radioactive products is independent of proton energy from 0.3 to 3 Bev. The validity of this assumption is examined. (auth)

6075

NUCLEAR REACTIONS OF COPPER WITH VARIOUS HIGH-ENERGY PARTICLES. G. H. Coleman and H. A. Tewes (Univ. of Calif., Livermore). Phys. Rev. **99**, 288-9(1955) July 1.

A study of the spallation of copper by 90-Mev neutrons, 90-Mev protons, and 190-Mev deuterons has been made. Radiochemical methods have been employed to determine absolute cross sections for the production of a number of nuclides produced by the interaction of these high-energy particles with copper. (auth)

6076

14-MEV (n, α) CROSS SECTIONS IN ZIRCONIUM. I. J. E. Brolley, Jr., M. E. Bunker, D. R. F. Cochran, R. L. Henkel, J. P. Mize, and J. W. Starner (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. **99**, 330(1955) July 1.

Zirconium metal was bombarded with 14-Mev Cockcroft-Walton neutrons. Strontium was separated from the zirconium and counted for γ activity. The resulting (n, α) cross sections are markedly lower than those previously reported. (B.J.H.)

6077

14-MEV (n, α) AND (n, p) CROSS SECTIONS IN ZIRCONIUM. II. A. H. Armstrong and J. E. Brolley, Jr. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. **99**, 330-1(1955) July 1.

Zirconium was bombarded with 14-Mev neutrons from the $\text{H}^3(d, n)\text{He}^4$ reaction and nuclear plates were used to detect reaction products. Cross sections for (n, p) and (n, α) reactions confirm the low value for the (n, α) cross section reported in the preceding Letter (see preceding abstract). (B.J.H.)

6078

14-MEV (n, α) CROSS SECTION IN ZIRCONIUM. III. F. L. Ribe and R. W. Davis (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. **99**, 331-2(1955) July 1.

Zirconium metal was bombarded with 14-Mev neutrons from the $\text{H}^3(d, n)\text{He}^4$ reaction, and resultant α particles were detected with a counter telescope. The angular dependence of the differential cross section of normal zirconium for the (n, α) reaction is shown. The smallness of the Zr^{90} and Zr^{94}

(n, α) cross sections, reported in a preceding Letter is confirmed (see preceding abstracts). (B.J.H.)

6079

ATTEMPT TO DETECT THE H^4 NUCLEUS AMONG THE PRODUCTS OF CARBON FISSION BY PROTONS OF 300 MEV ENERGY. A. A. Reut, S. M. Korenchenko, V. V. Yur'ev, and B. M. Pontecorvo (Inst. of Nuclear Problems). Doklady Akad. Nauk S.S.S.R. **102**, 723-5(1955) June 1. (In Russian)

The cross section for the formation of β -active ($E_\beta \sim 12$ Mev) nuclides of 2 to 4 msec half life was found to be 10^{-30} cm^2 , and of 4 to 10 msec half life, 10^{29} cm^2 . The reaction sought was $\text{H}^4 \rightarrow \text{He}^4 + \beta^- + \gamma$. (G.Y.)

6080

ON THE EXCITED LEVELS OF Li^7 AND Be^8 FROM THE DISINTEGRATION OF Be^9 BY DEUTERONS OF LOW ENERGY. P. Clüer and J. J. Jung. J. phys. radium **16**, 385-7(1955) May. (In French)

The study of the products of the competitive reactions, $\text{Be}^9(d, \alpha)\text{Li}^7 \rightarrow \alpha + t$ and $\text{Be}^9(d, t)\text{Be}^8$ by deuteron energy equal to 1.25 Mev permits definition of the first excited levels of Li^7 and Be^8 . The photographic method, after magnetic sorting of the emitted particles, was used. In the first reaction, the end of a triton continuum clearly indicates an important contribution of the 4.6 Mev level of Li^7 and the residual tritons probably provide a level of about 6.7 Mev. The level at 5.5 Mev proposed by Stoll has not been detected. With the second reaction, between 0 and 3 Mev only the conventional level at 2.8 Mev has been observed for Be^8 , in accordance with the results of authors using the $\text{B}^{10}(d, \alpha)^*\text{Be}^8$ reaction. (B.J.H.)

6081

CHLORINE 38, 34 RATIOS FROM HEAVY ION BOMBARDMENTS. A. E. Souch (Univ. of Birmingham, England). Phil. Mag., (7), **46**, 566-9(1955) May.

A study was made of the $\text{Cl}^{38}/\text{Cl}^{34}$ ratio from C^{13} , N^{14} , and O^{16} bombardments of aluminum using charge-discrimination devices in analysis. Results are tabulated. For various bombarding particles the ratio varies from 3 to 22%. (B.J.H.)

6082

ON THE ACTIVATION CURVES BY THE (γ, n) REACTION NEAR THE THRESHOLD. Robert Basile and Claude Schuhl. Compt. rend. **240**, 2399-2401(1955) June 20. (In French)

The activation curve of the $\text{P}^{31}(\gamma, n)\text{P}^{30}$ reaction shows some breaks. Its study permits determination of the threshold of this reaction: 12.33 ± 0.05 Mev at the energy of the breaks: 12.58 ± 0.07 Mev, 12.75 ± 0.08 Mev, 12.90 ± 0.08 Mev, 13.18 ± 0 Mev, and 13.38 ± 0.10 Mev. (tr-auth)

6083

RANGE OF P^{32} AND S^{35} ISOTOPES PROJECTED AT THE TIME OF THE $\text{S}^{32}(n, p)\text{P}^{32}$ AND $\text{S}^{34}(n, \gamma)\text{S}^{35}$ NUCLEAR REACTIONS. Jules Pauly. Compt. rend. **240**, 2415-17(1955) June 20. (In French)

Some fine suspensions of S in water were irradiated with neutrons, and P^{32} projected in the liquid phase was extracted with efficiencies reaching 75%. For S^{35} the energy of the atoms undergoing the recoil is weak, and this isotope does not get over the surface of the grains. The ranges of the trajectories are determined for P^{32} and S^{35} . (tr-auth)

PARTICLE ACCELERATORS

6084 CERN-PS/MM-16

[European Organization for Nuclear Research, Geneva]. MESURES DYNAMIQUES PRELIMINAIRES SUR LES

MODELES AC VI ET AC VII. (Preliminary Dynamic Measurements on the Models AC VI and AC VII). May 1955. 14p.

The AC VI and AC VII are models of the CERN proton synchrotron magnet, designed to investigate the relationship between eddy currents and steel lamination thickness. The two models are similar in construction to the AC V, except that a closed cross section was used. The AC VI and AC VII models were identical except for the laminar thicknesses of 1 and 10 mm, respectively. (K.S.)

6085 CERN-PS/MM-17

[European Organization for Nuclear Research, Geneva]. MESURES STATIQUES DU CHAMP MAGNETIQUE ET DE SON GRADIENT SUR LES MAQUETTES VI ET VII. (Static Measurements of the Magnetic Field and its Gradient on Mockups VI and VII). May 1955. 21p.

A mockup of the CERN synchrotron magnet with a closed cross section yields much larger variations in the value of n for weak fields than a mockup of open cross section. For average and saturation fields, the differences are very small. The use of annealed Fe reduced the residual field and improved the homogeneity of the field for low values. It follows that the variations of n and the differences between open and closed mockups are reduced at the injection. (tr-auth.)

6086 55-RL-1315

General Electric Co. Research Lab., Schenectady, N. Y. VACUUM SYSTEM FOR 300-MEV NONFERROMAGNETIC SYNCHROTRON. W. B. Jones, H. R. Kratz, J. L. Lawson, D. H. Miller, R. D. Miller, G. L. Ragan, J. Rouvina, and H. G. Voorhies. June 1955. 11p. Contract N70nr-332.

The vacuum system for the 300-Mev nonferromagnetic synchrotron is described. The factors entering into the present design of this system are considered. Typical operational data for the system are given. (auth)

6087

THE 156-IN. CYCLOTRON AT LIVERPOOL. M. J. Moore (Univ. of Liverpool, England). *Nature* 175, 1012-15 (1955) June 11.

The cyclotron building is discussed fully with emphasis being placed on shielding considerations. Details of the cyclotron construction are also given. A proton beam, extracted by the "peeler-regenerator" method, is available at a 3×10^{-2} μ amp current and at 383 Mev. Neutrons of 200 to 400 Mev are available and provisions are made for the extraction of 150 and 96 Mev pion beams. (B.J.H.)

5088

PREPARATION OF METALLIC ISOTOPIC TARGETS OF THE ALKALI AND ALKALINE EARTH METALS BY EVAPORATION OF THEIR COMPOUNDS. D. H. Randall and M. L. Smith (Atomic Energy Research Establishment, Harwell, Berks, England). *Nature* 175, 1041-2 (1955) June 11.

A method is given for the preparation of metallic isotopic targets of alkali and alkaline earth metals by vacuum evaporation of their oxides or carbonates from a tantalum backing. (B.J.H.)

6089

THE SYNCHROTRON AND ITS PROBLEMS. E. Persico (Univ. of Rome). *J. phys. radium* 16, 360-5 (1955) May. (In French)

The essential parts of a synchrotron and the principle of its operation are reviewed. A brief outline is given of the

problems which the project of such a machine poses, notably the calculation of the horizontal and vertical oscillations of the particles, which strongly influence the dimensions and the cost of the machine. The theory of relativity plays an essential role in these calculations. Finally the principle of "intense focusing" is explained, aiming at the reduction of the mentioned amplitudes. (tr-auth)

6090

ENERGY CALIBRATION OF A 22 MEV BETATRON. R. Basile and C. Schuhl. *J. phys. radium* 16, 372-7 (1955) May. (In French)

The 22 Mev Allis Chalmers betatron of the "Commissariat à l'Énergie Atomique" situated at the Institute G. Roussy de Villejuif is calibrated. The thresholds of the (γ, n) reactions on C^{12} , O^{16} , Cu^{63} , and Ag^{108} are used as energy reference points. As a by-product, the threshold of the $Fe^{54}(\gamma, n)Fe^3$ reaction ($13.65 \pm .05$ Mev) and the difference in thresholds between the $Ag^{106}(\gamma, n)Ag^{106}$ and the $Ag^{108}(\gamma, n)Ag^{108}$ reactions (400 ± 60 kev) are measured. (tr-auth)

6091

THE INELASTIC SCATTERING OF PARTICLES ACCELERATED IN A SYNCHROTRON. Joseph Seiden and Francois Lurcat. *Compt. rend.* 240, 2067-9 (1955) May 23. (In French)

A theoretical discussion is given on the synchrotronic oscillations resulting from the loss of energy undergone by a synchrotron accelerated particle when it undergoes inelastic collisions with molecules of residual gas in the synchrotron. The amplitude maxima of the oscillations are calculated, and it is concluded that the loss of protons due to this process is very small. (B.J.H.)

RADIATION ABSORPTION AND SCATTERING

6092 AECU-3048

Los Alamos Scientific Lab., N. Mex.

PULSED PHOTOMULTIPLIERS FOR FAST SCINTILLATION COUNTING. Sidney Singer, Leland K. Neher, and Robert A. Ruehle. [1955?]. 17p. Contract [W-7405-eng-36].

A pulsed 931-A multiplier and TW-10 traveling-wave oscilloscope have been used to measure the decay times of three fast scintillators. Experiments concerning the linearity of a pulsed multiplier and the maximum attainable collector currents are also described. It appears that the secondary emission process can give rise to an oscillation which may limit the application of pulsed multipliers. (auth.)

6093 CVAC-170T

Consolidated Vultee Aircraft Corp., Fort Worth, Tex.

AIR AND GROUND SCATTERING OF COBALT 60 GAMMA RADIATION. B. L. Jones, J. W. Harris, and W. P. Kunkel. Mar. 30, 1955. 38p. Contract AF33(038)-21117. (FZK-9-051)

Air and ground scattering of Co^{60} γ radiation has been experimentally investigated for source-receiver separation distances from 7.5 to 70 feet and for heights above ground from 9 to 57 feet. Light-weight television antenna towers were used to support the source and detector at various heights and separation distances. One tower was used to support the detector and a $4'' \times 4'' \times 8''$ lead brick. The lead brick was used to attenuate the direct beam so that only scattered radiation was measured. The detector tower was mounted on a dolly, allowing the source-detector

separation distance to be controlled remotely. A second tower was used to support a cable and pulley arrangement that permitted the source height to be remotely controlled. The detector employed was an anthracene scintillation dosimeter. The anthracene crystal was mounted on an RCA-5819 photomultiplier tube from which the integrated signal current was obtained and measured. Dark current compensation and a magnetic shield were incorporated in the design. Linearity of response to radiation intensity and the effect of temperature changes on response were checked. The experimental results show that the dose rate at the detector due to scattered radiation was negligibly affected by changes in height after a height of about 45 feet had been reached. It was concluded, therefore, that the data for heights greater than 45 feet was about equal to that which would result from air scattering alone in the absence of the ground. The raw data for heights greater than 45 feet and for separation distances greater than 35 feet closely fit a straight line plot on log-log paper. The variation of the air scattered dose rate thus fits a straight line corresponding to a variation $1/a^n$. The best value of the exponent of a was found to be $n = 1.06 \pm 0.02$. (auth)

6094 UCL-3046

California. Univ., Berkeley. Radiation Lab.
THE ALPHA-TRACK COUNTER (thesis). Archie B. Treadwell. June 1955. 51p. Contract W-7405-eng-48.

An alpha-track counter has been constructed which automatically counts and records alpha tracks on 5 by 22 cm glass photographic plates from the alpha spectrometer. The tracks, 3 by 150 microns in size, are parallel to the long dimension of the plate. The instrument scans the photographic plate in 900 strips 0.25 by 50 mm, each strip being associated with a particular energy. The number of tracks in each strip is counted and 900 points on the energy distribution curve are automatically plotted by a Speedomax recorder. When long thin objects such as nuclear tracks are illuminated by rotating oblique dark-field illumination, they flash on and off, because light is preferentially scattered from their long dimension. The optical system of the alpha-track counter consists of a 240-power binocular microscope with a modulated dark-field illumination system that causes the tracks to flicker at a 600 cps rate. The modulation is accomplished by a polaroid filter rotating at 18,000 rpm and a stationary "analyzer" filter. A photomultiplier that has replaced one of the oculars of the microscope generates a few cycles of 600 cps voltage as a track passes under the ocular slit during a scan. The electronic system amplifies the photomultiplier signal and discriminates against the many spurious signals produced by dust particles, scratches, random grain clumpings, and other imperfections in the emulsion. In order for a signal to pass the discriminators and be recorded, it must be of the correct amplitude and phase, and consist of the correct number of cycles. The instrument counts about 60% of the tracks in a given strip and introduces about 100 spurious counts per strip, so that its use is limited to strips containing more than 200 tracks. Work is continuing to improve its performance. (auth)

6095 USNRDL-TR-33

Naval Radiological Defense Lab., San Francisco.
A STANDARD ROENTGEN RAY FACILITY. L. E. Hollander. Feb. 9, 1955. 26p.

The modification of a commercial x-ray unit to provide a standard radiation source is described. This

unit features a 20-kw electronic voltage regulator, a 2-ton lead shield, and a 250-kv voltmeter. The modifications eliminate many experimental errors presently prevalent. Useful absorption curves for the spectral determination of x rays, the method of deriving them, and discussion of their limitations are presented. The use of radioactive isotopes to supplement the x-ray spectrum is also discussed. A secondary radiation standard featuring a National Bureau of Standards cavity ionization chamber and a vibrating reed electrometer is described. (auth)

6096 AERE-Lib/Trans-515

THE SCATTERING OF NEUTRONS WITH AN ENERGY OF SEVERAL DEGREES IN LIQUID HELIUM II. I. M. Khalatnikov and V. N. Zharkov. Translated by V. Beak from *Doklady Akad. Nauk S.S.S.R.* 93, 799-802(1953). 4p.

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 8-2031.

6097

THEORY OF FLUIDS AND THE PREDICTION OF X-RAY SCATTERING. G. Fournet (Ecole Supérieure de Physique et Chimie, Paris). *J. phys. radium* 16, 395-400(1955) May. (In French)

A search has been made for what various theories of fluids allow to be predicted on the subject of x rays scattered by these fluids. In order to profit from the maximum of existing diverse theories, the subject was confined to the examination of groups of identical hard spheres, without other interaction than their impenetrability. It has been found that these diverse theories of fluids do not predict correctly the intensity of scattered x radiation. The errors are accordingly smaller as the ratio $\sin \theta/\lambda$ is larger and it was possible, nevertheless, to reach useful conclusions on the angular position of the maxima of the scattered intensity. (tr-auth)

6098

SOME EXPERIMENTAL RESULTS OBTAINED WITH THE AID OF PHOTOGRAPHIC PLATES BOMBARDED BY HIGH ENERGY NUCLEONS. Jean Combe (Institut de Physique, Strasbourg). *J. phys. radium* 16, 445-57(1955) June. (In French)

Some results are given of the study of stars produced in photographic emulsions by high-energy nucleons (340 Mev). Particular attention was given to the energy branches ($E > 30$ Mev) which go out from these stars (energy distribution, angular distribution, nature, etc.). Results are given separately for the light nuclei of the emulsions (C, N, O) and the heavy nuclei (Ag, Br). Some differences appear in the behavior of these two kinds of nuclei, explainable by a difference of instantaneous structure (α cellules or others in the light nuclei; nucleon gas in the heavy nuclei). On each plate, a "number of energy-grains" curve for protons (up to energies of 340 Mev) has been established. p-p collisions were used for this. Likewise, a method of precise measurement of the contraction factor S ($dS = 0.025$) of the emulsion has been given. (tr-auth)

6099

DETERMINATION OF RADON IN URANIUM MINES BY THE METHOD OF RETENTION ON CHARCOAL. Mlle Cadudal. *J. phys. radium* 16, 479-82(1955) June. (In French)

A method of determination of atmospheric radon is described. This method utilizes the absorption of radon on active charcoal. The β rays emitted by the RaC in the

midst of the active charcoal is counted immediately with a Geiger counter. The volumes of sampled air vary between 10 and 200 liters. The sensitivity is limited to 10^{-12} curies/liter. The accuracy is of the order of 7%. This method is destined for the control of radon concentrations in the atmosphere of mines or of localities containing uranium. The sample takes 5 minutes, the collection of portable apparatus weighs about 2 kg, and has a range of about 15 hours. (tr-auth)

6100

ELASTIC SCATTERING OF PROTONS BY F^{19} . T. S. Webb, F. B. Hagedorn, W. A. Fowler, and C. C. Lauritsen (California Institute of Tech., Pasadena). *Phys. Rev.* **99**, 138-45 (1955) July 1.

The differential cross section for the elastic scattering of protons by F^{19} has been measured for proton energies from 550 to 1800 kev at center-of-mass angles of 90, 125.3, and 159.8 degrees and for proton energies from 1300 to 1500 kev at 53.2, 60, 70, 80, 100, 110, and 136 degrees. Marked scattering anomalies were observed for proton energies near 669 (1^+), 843 (0^+), 873 (2^-), 935 (1^+), 1346 (2^-), 1372 (2^-), 1422 (1^+), and 1700 kev. The indicated spin and parity assignments for the corresponding levels in Ne^{20} are required by the results of this experiment or are consistent with them. Observations of the elastic scattering have also been made in the regions of 340 and 480 kev at 159.8 degrees, and no anomaly was observed in either case. The ambiguity in the choice of Γ_p/Γ has been resolved for several of the Ne^{20} levels. An approximate method of correcting the observed cross sections for the effects of finite energy resolution has been developed, and the relative stopping cross section for protons in lithium fluoride has been measured for proton energies from 400 to 1600 kev. (auth)

6101

ANALYSIS OF THE ELASTIC SCATTERING OF PROTONS FROM F^{19} . Elizabeth Urey Baranger (California Institute of Tech., Pasadena). *Phys. Rev.* **99**, 145-9 (1955) July 1.

An analysis of the anomalies in the elastic scattering cross section of protons on F^{19} has been carried out. The assignments 1^+ for the resonances at 669, 935, and 1422 kev, and 0^+ for the resonance at 843 kev, are required by the results of the experiment. The assignment of the resonances at 873, 1348, and 1374 kev is 2^- , with 1^- not excluded by these data alone. Unique values of the partial widths are determined for these resonances and several others in this energy range. Reduced widths are given for the various particle reactions which are observed. (auth)

6102

MANGANESE THERMAL NEUTRON ACTIVATION CROSS SECTION. J. DeJuren and J. Chin (National Bureau of Standards, Washington, D. C.). *Phys. Rev.* **99**, 191 (1955) July 1.

The thermal activation cross section of manganese has been remeasured and found to be $\sigma_{act} = 13.1_9 \pm 0.3_9$ barns (standard error). This value, combined with previous values, yields a "best average value" of $13.2_7 \pm 0.2$ barns. (auth)

6103

SLOW-NEUTRON-INDUCED RADIOACTIVITY OF SEAWATER. D. Dyrssen and P. O. Nyman (Research Institute of National Defense, Sundbyberg, Sweden). *Acta Radiol.* **43**, 421-7 (1955) May.

The radioactivity induced in sea water is calculated for 1 gram of slow neutrons. A simple relation is given for the

effect of the salt content on this activity. A table shows both the total activity and the activities for individual isotopes as a function of time. (auth)

6104

NUCLEAR ISOMETRY OF Se^{81} . ANALYSIS OF THE RELATION OF THE CAPTURE CROSS SECTION AS A FUNCTION OF INCIDENT NEUTRON ENERGY. P. C. Capron and E. F. Crevecoeur. *Bull. classe sci. Acad. roy. Belg.* **40**, No. 11, 1214-23 (1954). (In French)

The study of the relation of the effective neutron capture cross sections by Se^{80} to form the Se^{81} isomers shows a large variation as a function of incident neutron energy. Attempts at interpretation, based on the difference of spin between the complex level and the two isomeric states have been made. A period which normally cannot appear by the (n,γ) reaction is detected there. (tr-auth)

RADIATION EFFECTS

6105 ER-6119

Martin (Glen L.) Co., Baltimore.

INDUCED RADIOACTIVITY OF SOME STRUCTURAL ALLOYS. Marx D. Moller. Jan. 1954. 32p. (AD-34029)

A study was made of available data on the effects of radiation from an operating nuclear reactor on exposed structures and mechanisms. A method of calculating values of induced radioactivity for elements and alloys was evolved. Metals and alloys commonly used in aircraft structure were considered, such as alloys of Al, Mg, Ti, Ni, and Fe. By the use of certain simplifying assumptions in the calculations, a comparison was made of the induced radioactivity properties of various alloys. The primary reactor radiation of the intensities studied had little effect on the physical properties of the metals and alloys. The materials did exhibit induced radioactivity after shutdown of the reactor. The intensity and duration of the induced activity varied with different alloys as well as with the intensity and duration of the primary radiation. In the alloys investigated, the radioactivity consisted of β particles, γ rays, or a combination of the two. (ASTIA abst.)

6106

CHEMICAL EFFECTS OF IRRADIATION BY HEAVY PARTICLES: USE OF THE FERROUS SULFATE-LITHIUM SULFATE SYSTEM AS A SIMULTANEOUS DOSIMETER FOR THERMAL NEUTRONS AND IONIZING RADIATION. I. Draganic and J. Sutton. *J. chim. phys.* **52**, 327-30 (1955) Apr. (In French)

In order to study the action of different high-energy heavy particles on aqueous systems, the products of the nuclear reaction, $Li^6(n,\gamma)H^3$, have been used as ionizing agents. The following results are relative to the oxidation of double sulfate solutions of iron II and of ammonium (Mohr salt) in 0.8 N. sulfuric acid containing as much lithium sulfate. The oxidation has been studied quantitatively as a function of the concentration of lithium and of the neutron dose, and the results show that the ferrous sulfate-lithium sulfate system can serve as a specific dosimeter for thermal neutrons in the presence of other ionizing radiations or as a total dosimeter when the ratio of thermal neutrons to other radiations stays constant. (tr-auth)

6107

THE EFFECT OF NUCLEAR RADIATION ON THE STRUCTURE OF ZIRCON. Heinrich D. Holland (Princeton Univ.,

N. J.) and David Gottfried (Geological Survey, Washington, D. C.) Acta Cryst. 8, Pt. 6, 291-300(1955) June 10.

The effect of nuclear radiation from the decay of uranium, thorium and their daughter elements on the specific gravity, unit-cell dimensions, and optical properties of zircon has been studied. During the course of the irradiation the specific gravity of zircon drops 16%, the material becomes isotropic and so disordered as to fail to yield recognizable x-ray-diffraction peaks. It is proposed that the observed effects are predominantly due to the displacement of atoms by recoil nuclei and by high temperatures generated in the path of nuclear particles. The breakdown of the structure is envisaged as a four-stage process in which the structure is first saturated with displacements; the saturated structure then breaks down into crystallites of ordered zircon which ultimately break down into a glass. (auth)

6108

THE CHEMICAL EFFECTS OF IONISING RADIATION IN SOLIDS-I. H. G. Heal (Queen's Univ., Belfast, Ireland). Atomica 6, 205-8(1955) July.

A brief review of the theory of radiation effects, of ionization and excitation in crystals, and general chemical effects of radiation is given. A bibliography of more recent literature is presented. (B.J.H.)

RADIOACTIVITY

6109

ON THE RADIATION EMITTED IN THE COURSE OF THE $\text{RaC} \rightarrow \text{AcX}$ TRANSMUTATION. Marcel Frilley, Salomon Rosenblum, Manuel Valadares, and Georges Bouissieres (Laboratoire Curie, Paris and Laboratoire du Grand aimant permanent, Bellevue, France). J. Phys. radium 16, 378-84 (1955) May. (In French)

The analysis of results of the fine structure of the α rays and of the diffraction of the γ rays, compared to new information on internal conversion electrons obtained in a magnetic spectrometer, is extended to energies of 100 to 335 kev. A level scheme for AcX^* is established which is compatible with the results of three methods. The nature and the polarization of the γ rays are determined. An evaluation of the internal conversion coefficient of the 50-kev ray is made. The result is comparable to that which we have obtained before and in accord with the theoretical value. (tr-auth)

6110

STUDY OF THE DISINTEGRATION OF Pd^{103} . P. Avignon, A. Michalowicz, and R. Bouchez (Laboratoire Curie, Paris). J. phys. radium 16, 404-10(1955) May. (In French)

The disintegration of Pd^{103} has been studied using a thin-lens β spectrometer and a γ scintillation spectrometer, particularly in the low-energy region. Besides the Auger rays and the K and L conversion electrons from the 40-kev γ , L electrons from a 53-kev γ and the K and L electrons from a 320-kev γ were observed with the β spectrometer; besides the K(Rh) rays, 40-kev γ , 65-kev γ , 300-kev γ , 365-kev γ , and 498-kev γ rays, but not the 53-kev γ ray, were observed with the γ spectrometer. The results permit determination of conversion coefficients for the 40-kev γ , and knowledge of the K captures of Pd^{103} . The captures near 300 and 365 kev are probably first order forbidden with $\Delta J = 2$ and $\Delta J = 1$. The 53-kev transition remains difficult to interpret. (tr-auth)

6111

DISINTEGRATION OF Sm^{153} . N. Marty (College de France).

J. phys. radium 16, 458-61(1955) June. (In French)

The β spectrum of Sm^{153} is decomposed into three spectra of maximum energies: 820 ± 10 kev; 720 ± 15 kev; and, 650 ± 15 kev. The 103-kev γ conversion coefficients are measured ($\alpha_K = 1.2 \pm 0.1$; $K/L = 6.2 \pm 0.3$; $L/M = 4.5$). The existence of low intensity 545- and 172-kev γ rays is confirmed, and evidence is given for conversion rays of a weak 84-kev γ ray. A logical decay scheme is given. (tr-auth)

6112

STUDY OF COINCIDENCE METHODS APPLIED TO THE ABSOLUTE STANDARDIZATION OF Na^{24} , Co^{60} , AND Sc^{46} . S. Vuccino (Institut du Radium, Paris). J. phys. radium 16, 462-8(1955) June. (In French)

The principle of coincidence methods, applied to the absolute standardization of artificial radio elements, is briefly reviewed. A simplified installation is described, including a thin end-window β counter and a scintillation counter for photon detection, as well as an installation with two scintillation counters. The standardizations are effected, on one hand in detecting the coincidences between a β particle and a photon, and on the other hand in detecting the coincidences between two photons in cascade, taking into account the angular correlations. To this end, the measurements under different angles have been accomplished with two scintillation counters. The results of standardization of Co^{60} , Na^{24} , and Sc^{46} by the two methods are given. The results have been checked in France and abroad by comparing them to those obtained with the same solutions, but by using different methods. (tr-auth)

6113

SCINTILLATION TECHNIQUES FOR THE DETECTION OF NATURAL RADIOCARBON. B. L. Funt, S. Sobering, R. W. Pringle, and W. Turchinets (Univ. of Manitoba, Winnipeg, Canada). Nature 175, 1042-3(1955) June 11.

A method is described wherein the carbon content of a sample can be incorporated into a liquid scintillator. The synthesis and use of toluene as the solvent in a liquid scintillator is described. (B.J.H.)

6114

LVII. RADIOACTIVE $^{184}\text{TANTALUM}$. F. D. S. Butement and A. J. Poe (Atomic Energy Research Establishment, Harwell, England). Phil. Mag., (7), 46, 482-4(1955) May.

The new isotope Ta^{184} has been produced and its decay characteristics determined as follows:

Half life	8.7 ± 0.1 h
β energy (Mev)	0.15, 1.26
γ energy (kev)	110, 160, 210, 240, 300, 405, 780, 890, 1180.

The mass assignment of this isotope was confirmed by its preparation by a (n, p) reaction on tungstic acid enriched in W^{184} . (auth)

6115

ON A NEW METHOD FOR STUDYING RADIOACTIVE PHENOMENA: CINENUCLEOGRAPHY. APPLICATION TO THE MEASUREMENT OF THE PERIOD OF $\text{RADIUM C}'$. Marcel Laporte. Compt. rend. 240, 2069-71(1955) May 23. (In French)

A source of pure RaC' , vaporized on the periphery of a revolving disk, is carried away under a nuclear plate; its diminution manifests itself by that of the density of the traces whose counting leads to a direct determination of the half life, $T = 1.5 \times 10^{-1}$ sec. (tr-auth)

6116

CHANGE IN ATMOSPHERIC RADIOACTIVITY OF THE PARIS AREA. Marcel Abribat, Jacques Pouradier, and Anne-Marie Venet. *Compt. rend.* **240**, 2310-12(1955) June 13. (In French)

Air and rain samples have been taken since 1951, and increases in radioactivity were noted following atomic explosions in the United States and in Russia. Those in Australia and the South Pacific were less evident. Histograms of radioactivity are given. (B.J.H.)

6117

GAMMA-RAY SPECTRUM OF POLONIUM-209. E. H. Daggett and G. R. Grove (Mound Lab., Miamisburg, Ohio). *Phys. Rev.* **99**, 1-2(1955) July 1.

A polonium sample was produced at Oak Ridge National Laboratory by the bombardment of bismuth targets with 20-Mev protons. The sample contained a mixture of the polonium isotopes of mass 208 and 209 with a negligible amount of the isotope of mass 210. Measurements were made of the isotopic ratio from the molecular spectrum and the alpha activity was determined by calorimetry. The spectrum obtained with a NaI(Tl) crystal and pulse-height analyzer showed the existence of gamma rays with energies of about 270, 570, and 865 kev. The 803-kev gamma ray of Po^{210} was not detected. This spectrum is attributed to Po^{209} since there is no gamma radiation from Po^{208} . The intensity of the 865-kev gamma ray relative to the gamma ray of a calibrated Po^{210} sample was estimated to be about 7.5×10^{-3} quanta per Po^{209} alpha particle. Coincidence measurements between various pairs of gamma rays indicated that only the 270- and 570-kev quanta were in cascade and existed with about the same relative intensity as the 865-kev gamma ray. (auth)

6118

RELATIVE INTENSITIES OF THE RADIATIONS FROM Hf^{175} . A. O. Burford, J. F. Perkins, and S. K. Haynes (Vanderbilt Univ., Nashville, Tenn.). *Phys. Rev.* **99**, 3-6(1955) July 1.

The intensities of the electronic and electromagnetic radiations of Hf^{175} have been measured with a magnetic-lens spectrometer. The existence of transitions of 89.1, 113.4, 228, 318, 342.3, and 431 kev was confirmed. For the 89.1-kev transition $\alpha_K = 3.5^{+1.5}_{-2.5}$, $\alpha_K/\alpha_L = 6.0 \pm 1$, $\alpha_L/\alpha_N = 3.5 \pm 0.9$, and the transition is predominantly M1. For the 228-kev transition $\alpha_K/\alpha_{L+M} = 2.0 \pm 0.5$ and the transition is of the type E2. For the 342.3-kev transition $\alpha_K/\alpha_{L+M} = 4.94 \pm 0.5$, and the transition is a mixture of M1 and E2. A decay scheme is given in which the ground state of Lu^{175} is characterized as $\Omega = 7/2$, $I = 7/2$, parity even; the 113.4-kev state is the first rotational excited state with $\Omega = 7/2$, $I = 9/2$, parity even; the 342.3-kev state is a single-particle excited state with $\Omega = 5/2$, $I = 5/2$, parity even; and the 431-kev state is the first rotational excitation of the 342.3-kev state with $\Omega = 5/2$, $I = 7/2$, parity even. (auth)

6119

GAMMA RAYS OF TELLURIUM-131 AND TELLURIUM-129. C. A. Mallmann, A. H. W. Aten, Jr., D. R. Bes, and Clara M. De McMillan (Comision Nacional de la Energia Atomica, Buenos Aires, Argentina). *Phys. Rev.* **99**, 7(1955) July 1.

The γ rays of Te^{131} and Te^{129} have been investigated by means of a crystal spectrometer. (auth)

6120

ALPHA SPECTRUM IN THE DECAY OF Li^8 . R. T. Frost and S. S. Hanna (Johns Hopkins Univ., Baltimore, Maryland). *Phys. Rev.* **99**, 8-9(1955) July 1.

The alpha-particle spectrum in the successive beta-alpha decay of Li^8 was observed with magnetic analysis from 1 to 6.5 Mev, corresponding to excitation energies in Be^8 from 2 to 13 Mev. The only definite structure in the spectrum corresponds to the well-known broad state at 2.9 Mev. (auth)

6121

DECAY PROPERTIES OF U^{232} . Frank Asaro and I. Perlman (Univ. of California, Berkeley). *Phys. Rev.* **99**, 37-41(1955) July 1.

The alpha and gamma spectra of U^{232} have been studied with an alpha-particle spectrograph and gamma-ray scintillation, proportional, and coincidence counters. Alpha groups of 5.318 Mev (68%), 5.261 Mev (32%), and 5.134 Mev (0.32%) and gamma rays of 57.9 kev (0.21%), 131 kev (0.075%), 268 kev (0.004%), and 326 kev (0.004%) were observed. The half life of the 58-kev first excited state of Th^{228} was found to be less than 10 microseconds. Spins and parities are assigned to the energy levels, and the results are evaluated with respect to the developing theory and systematics of complex alpha spectra and excited states of even-even nuclei. (auth)

6122

BETA EMITTER Np^{238} . I. BETA SPECTROSCOPY. John O. Rasmussen and Thomas O. Passell (Univ. of California, Berkeley) and Hilding Slatis (Nobel Inst. of Physics, Stockholm). *Phys. Rev.* **99**, 42-7(1955) July 1.

The beta decay of Np^{238} has been studied with several beta spectrometers. In addition to the known conversion lines corresponding to transitions of energies now determined as 44.0, 102.2, 986, and 1029 kev, new conversion lines, corresponding to transitions of 942 and 927 kev were found. These transitions indicate the presence of closely spaced levels at higher excitation energies. Intensities of conversion lines and beta groups were determined and compared with previous work. Fermi-Kurie plots confirm the allowed shape of the hard beta group (1.25 Mev) and give indication of complexity in the soft beta group (0.27 Mev). The energy deviations of the ground rotational band levels from the simple rotational energy formula are discussed. (auth)

6123

BETA EMITTER Np^{238} . II. SCINTILLATION SPECTROSCOPY AND COINCIDENCE STUDIES. John O. Rasmussen, Frank S. Stephens, Jr., Donald Strominger (Univ. of California, Berkeley). *Phys. Rev.* **99**, 47-55(1955) July 1.

The relative intensities of electromagnetic radiation from Np^{238} , determined by scintillation spectroscopy, set an upper limit for K capture of $\text{K}/\beta < 1$ percent. On the basis of extensive scintillation counter coincidence measurements together with the beta spectroscopic results of the preceding article, two alternate decay schemes, differing only in minor detail, are proposed for Np^{238} . The levels of Pu^{238} involved are three close-lying ground rotational band members and a cluster of three levels near 1 Mev, two of which appear to belong to the same rotational band. Conversion coefficient determinations permit multipolarity assignment for a number of the gamma transitions and consequent spin and parity assignments for a number of excited states. Selection rules and other intensity rules involving the Bohr-Mottelson K-quantum numbers are tested, providing K-assignments for levels. There is a high degree of K-purity of those states where tests were possible. The question of possible "vibrational" character of the band near 1 Mev is discussed speculatively. (auth)

6124

SEARCH FOR DOUBLE BETA DECAY IN CADMIUM AND MOLYBDENUM. Rolf G. Winter (Western Reserve Univ., Cleveland, Ohio). *Phys. Rev.* **99**, 88-91(1955) July 1.

Random Wilson cloud-chamber photographs of cadmium and molybdenum foils show that the double negatron half life is greater than or equal to 1×10^{17} years in Cd^{116} and 3×10^{17} years in Mo^{100} , and that the double positron half life is greater than or equal to 6×10^{16} years in Cd^{106} and 4×10^{18} years in Mo^{92} . The background appears to be primarily caused by Compton electrons and photoelectrons ejecting other electrons on their way out of the foil and by photons that suffer two Compton scatterings while traversing the foil. (auth)

6125

OBSERVATION OF A 193-MILLIMICROSECOND METASTABLE LEVEL IN Pu^{239} . D. Engelkemeir and L. B. Magnusson (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **99**, 135-6(1955) July 1.

A metastable level in Pu^{239} with a half life of 193 μsec has been observed in the beta decay of Np^{239} . This metastable state is assigned to a level 382 keV above the ground state of Pu^{239} , and appears to de-excite by parallel 61- and 105-keV E_1 gamma transitions. (auth)

6126

ENERGY AVAILABLE FOR BETA DECAY OF Nd^{150} .

Benjamin G. Hogg (Royal Military Coll. of Canada, Kingston, Ontario). *Phys. Rev.* **99**, 175(1955) July 1.

A study of the beta decay systematics at mass number 150 suggests that the mass-spectrographically determined Nd^{150} - Sm^{150} difference of 4.6 ± 0.8 MeV is too high. If the recent value of Pm^{150} - $\text{Sm}^{150} = 5.3 \pm 0.15$ MeV is used with a graphically estimated value of 4.0 MeV for the Nd^{150} - Sm^{150} difference, then single beta decay of Nd^{150} is energetically impossible. (auth)

6127

HALF-LIFE OF Cs^{137} . D. M. Wiles and R. H. Tomlinson (Hamilton Coll., McMaster Univ., Hamilton, Canada). *Phys. Rev.* **99**, 188(1955) July 1.

The half life of Cs^{137} was found to be 26.6 ± 0.4 years by observing the disintegration rate of a known number of atoms. The disintegration rate was measured with a 4 π proportional counter and the number of atoms was determined from isotope dilution data obtained with a mass spectrometer. (auth)

6128

THEORETICAL ANALYSIS OF THE CHARGE DISTRIBUTION ON THE RECOIL Cl IONS FROM K CAPTURE IN A^{37} . R. A. Rubenstein and J. N. Snyder (Univ. of Ill., Urbana). *Phys. Rev.* **99**, 189-90(1955) July 1.

An analysis of the charge spectrum of the recoil Cl ions which result from K capture in A^{37} , recently measured by Kofoed-Hansen, is made using recently computed Auger transition rates. It is shown that this charge spectrum, a previously measured fluorescence yield of 0.1 in Cl , and a previously measured K/L capture ratio of 0.92/0.08 in A^{37} are not consistent. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

6129

MULTIPLETS CHARACTERISTIC OF RARE EARTHS IN THEIR X-RAY EMISSION SPECTRA. Paul Sakellariadis. *J. phys. radium* **16**, 422-7(1955) May. (In French)

The existence of the incomplete 4f shells in the rare earth elements, gives rise to very characteristic anomalies in their x ray spectra. Emission rays which do not exist for other elements have been pointed out within the region of the rare earths. On the other hand, one observes reductions of certain usually close dipolar emissions. In this article, the results are given of a systematic study of the emissions and multiplets characteristic of the L spectra of Eu, Gd, Tb, Ho, and Tm. (tr-auth)

SPECTROSCOPY

6130 AEC-tr-2193

OPTICAL CONDITIONS FOR THE USE OF PHOTOELECTRIC CELLS IN SPECTROGRAPHS AND INTERFEROMETERS. Pierre Jacquinot and Charles DuFour. Translated from *J. recherches centre natl. recherche sci. Labs. Bellevue (Paris)* **2**, 91-103(1948).

The principle properties of photographic apparatus and the uses of the photoelectric cell are reviewed. A general discussion of Fabry-Perot interferometers is also given, including geometrical studies and the preparation of an étalon cell apparatus. (B.J.H.)

THEORETICAL PHYSICS

6131 BNL-2129

Brookhaven National Lab., Upton, N. Y. ANALYTIC SPIN FUNCTIONS OF A SINGLE VARIABLE. E. V. Sayre and S. L. Matlow. [1954?]. 3p.

6132 UCRL-2747(Rev.)

California. Univ., Berkeley. Radiation Lab. HIGH-ENERGY MULTIPLE PHOTON PRODUCTION. R. Arnowitz and S. Deser. June 3, 1955. 18p. Contract W-7405-eng-48.

Multiple production of photons by fast elementary particles coupled strongly to the electromagnetic field is treated by semiclassical methods. In this approximation, the photons are treated in a precise quantum mechanical fashion, while the motion of the matter field is obtained by classical means but includes radiation reaction effects. As a specific example, the magnetic monopole is discussed (and another possible domain of applicability is pointed out). A possible connection with several recent cosmic ray events is investigated. It is shown that conventional electrodynamic models (including antiparticle annihilation) produce too few photons and magnetic monopoles too many, to account for the observed multiplicities. (auth)

6133

EFFECT OF SPIN-ORBIT INTERACTION ON PHOTO-NUCLEAR ELECTRIC DIPOLE ABSORPTION. Sherman Frankel (Univ. of Penna., Philadelphia). *Phys. Rev.* **99**, 169(1955) July 1.

The effect of a nuclear spin-orbit interaction of the form $\mathbf{d}_1 = \phi(\mathbf{r}) \mathbf{1} \cdot \boldsymbol{\sigma}$ on photonuclear electric dipole absorption is examined. It is found that the total cross section is unaffected and expressions for the (small) effect on the average energy of absorption are given. (auth)

6134

COLLECTIVE MODES IN NUCLEI. F. Coester (State Univ. of Iowa, Iowa City). *Phys. Rev.* **99**, 170-4(1955) July 1.

The Hamiltonian of the "unified model" of Bohr and Mottelson has been derived from many-particle quantum mechanics. A point transformation in the configuration space of the N nucleons of the core introduces 6 collective

coordinates describing the size and shape of the nucleus and $3N-6$ internal coordinates. The collective coordinates are essentially the components of the quadrupole moment tensor of the nucleon distribution. It is assumed that the wave function Ψ of the nucleus for the ground state and the low lying excited states can be approximated by the product $\Psi_0\Phi$ where Ψ_0 depends only on the internal coordinates of the core and Φ depends on the collective coordinates of the core and the coordinates of the external nucleons. $\Psi_0\Phi$ is treated as a trial function in the Schrödinger variational principle. For fixed Ψ_0 this yields a Schrödinger equation for Φ . The Hamiltonian in this equation is the Hamiltonian of Bohr and Mottelson plus certain correction terms. Ψ_0 influences the values of the constant parameters occurring in this Hamiltonian but not its structure. In the strong-coupling approximation the relationship between the moments of inertia of the core and the nuclear quadrupole moment is essentially the same as in the liquid drop model. This result is also independent of detailed assumptions about Ψ_0 . (auth)

6135

RENORMALIZATION IN THE NEW TAMM-DANCOFF THEORY OF MESON-NUCLEON SCATTERING. R. H. Dalitz (Cornell Univ., Ithaca, New York) and F. J. Dyson (Institute for Advanced Studies, Princeton, New Jersey). *Phys. Rev.* **99**, 301-14(1955) July 1.

The new Tamm-Dancoff equations for meson-nucleon scattering are set up in the lowest approximation and it is shown how explicit nonphysical singularities may be avoided in these equations. The particle self-energies appearing in the integral equation are renormalized, but the resulting modified propagator for the system then has a nonphysical singularity. For the states $T = j = 1/2$, the vertex and self-energy expressions generated by the uncrossed graph are considered. The renormalized vertex may be constructed by the successive solution of two one-dimensional integral equations, the finite part of the self-energy then being obtained by quadratures. Vertex renormalization is uncertain to a constant factor in the $S_{1/2}$ state, and the $S_{1/2}$ theory therefore depends on two parameters. No numerical results are obtained, owing to a number of difficulties found in this theory—a comparison is made between these difficulties and those of the corresponding Bethe-Salpeter equation. (auth)

6136

POSSIBLE MATHEMATICAL FORMULATION OF THE GELL-MANN MODEL FOR NEW PARTICLES. Bernard d'Espagnat and Jacques Prentki (CERN, Geneva, Switzerland). *Phys. Rev.* **99**, 328-9(1955) July 1.

The possibility that an equivalent of the Gell-Mann rules may be used to describe the existence and interaction of hyperons and heavy mesons is shown. (B.J.H.)

6137

STRAGGLING OF THE RANGE OF FAST PARTICLES AS A STOCHASTIC PROCESS. Alladi Ramakrishnan and P. M. Mathews (Univ. of Madras, India). *Pro. Indian Acad. Sci.* **41**, 202-9(1955) May.

A stochastic model is adopted to represent range straggling of heavy particles in matter. The stochastic equation of the probability of the particle having an energy between E and $E + dE$ is set up and evaluated numerically for various values of the particle's initial energy. (B.J.H.)

6138

UNITARY THEORY IN SIX DIMENSIONS. INTERPRETA-

TION FOR THE ELECTROMAGNETIC-MESON FIELD. Josette Renaudie. *Compt. rend.* **240**, 2380-2(1955) June 20. (In French)

In a six-dimensional Riemannian geometry, the equations of the vectorial-electromagnetic meson field are written $R_{\alpha\beta} - (1/2)\gamma_{\alpha\beta} R = (\mu^2/2)Q_{\alpha\beta}$ where $Q_{\alpha\beta}$ is defined as a function of two electromagnetic-meson 6-vectors. Cauchy's problem relative to these equations has at least one solution, in the case of information on a non-singular hypersurface. (tr-auth)

6139

ON THE RELATION BETWEEN RELAXATION TIME AND THE PROBABILITIES OF TRANSITION IN NUCLEAR RESONANCE (MAGNETIC AND QUADRUPOLE). Francois Lurcat. *Compt. rend.* **240**, 2402-3(1955) June 20. (In French)

6140

DYNAMICAL DESCRIPTION OF SCATTERING BY A TENSOR FORCE. Juan Manuel Lozano. *Rev. mex. fis.* **4**, 13-22(1955) Jan. (In Spanish)

In the present paper the dynamical description of scattering by tensor forces is discussed. A generalization of the dynamical description of scattering by a potential presented elsewhere is obtained. This problem has also the interest of being a simple example of a nuclear reaction with two channels, in which the S matrix is a meromorphic function of the wave number. (auth)

URANIUM AND URANIUM COMPOUNDS

6141 LA-493

Los Alamos Scientific Lab., N. Mex.

GRAPHICAL METHOD OF OBTAINING CRITICAL MASSES OF WATER-TAMPED WATER BOILERS. E. Greuling and C. Marvin. Apr. 5, 1946. Decl. July 7, 1955. 10p.

An approximate method of calculating the critical mass of U^{235} as a function of spherical core volume of a wide variety of enriched uranium in water solutions surrounded by water is outlined. The results are expressed in such a form that one may read, after selecting a single parameter, the critical mass of U^{235} and the corresponding core volume from the intersection of two superimposed curves. By choosing a series of values for the parameter, one may easily compute the critical mass of U^{235} as a function of core involved. This information is particularly useful for purposes of safety. One can rapidly obtain minimum critical masses and optimum water solution concentrations of several uranium compounds having various U^{235} isotope enrichment percentages. The approximations are in such a direction as to yield critical masses that are slightly low. (auth)

6142

PHOTOFISSION OF U^{238} . L. Katz, T. M. Kavanagh, A. G. W. Cameron, E. C. Bailey, and J. W. T. Spinks (Univ. of Saskatchewan, Saskatoon, Canada). *Phys. Rev.* **99**, 98-106 (1955) July 1.

Chemical separation of the products resulting from photofission at various maximum bremsstrahlung energies E_0 of U^{238} serve to define the 3-dimensional yield surface $S(Y, A, E_0)$. An analysis of this surface by the photon difference method established the 3-dimensional photofission cross section surface $S(\sigma, A, h\nu)$. The peak-to-valley cross section ratio (asymmetric to symmetric fission) is examined in some detail and the results are combined with

high-energy photofission data from the literature to extend our calculations and analysis to 300 Mev. (auth)

6143

DECAY OF U^{232} (74 YR). Gertrude Scharff-Goldhaber, E. Der Mateosian, G. Harbottle, and M. McKeown (Brookhaven National Lab., Upton, New York). Phys. Rev. **99**, 180-3 (1955) July 1.

The decay of the α emitter U^{232} (74 yr) was studied by means of γ -ray scintillation counters and by a technique involving the impregnation of a scintillating crystal with this source. Excited states were found at 60 kev, 190 kev, and 330 kev. The first two are interpreted as rotational states of character $2+$ and $4+$ and the third as probably a $1-$ state. The branching ratios for transitions from the 330-kev state to the $2+$ state and ground state are 57 percent and 43 percent respectively. The half life of the 60-kev state was found to be shorter than 2×10^{-8} sec, in contrast to earlier reports based on a study of the β^- decay of Ac^{228} . (auth)

6144

BOMBARDMENT ENERGY AND FISSION PRODUCT YIELD PATTERN FOR PROTONS ON NATURAL URANIUM AND U^{235} . W. H. Jones, A. Timnick, J. H. Paehler, and T. H. Handley (Oak Ridge National Lab., Tenn.). Phys. Rev. **99**, 184-7 (1955) July 1.

Relative fission yields of ten nuclides produced by proton-induced fission of natural uranium and U^{235} were determined at several proton energies in the range 12 to 20 Mev. The expected trend toward symmetric fission at increased energies is observed. A statistical relation is used to correlate this shift in fission symmetry with the excitation energy of the compound nucleus. (auth)

6145

ON AN ABNORMAL β RAY FROM METALLIC URANIUM. Georges Vacca and Louis Perreau. Compt. rend. **240**, 2404-5 (1955) June 20. (In French)

A phenomenon of superficial concentration of β activity has been verified after heat treatment of uranium. (tr-auth)

